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"*To the solid ground*
Of Nature trusts the mind which builds for aye."—WORDSWORTH

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Reviews and Our Bookshelf.

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NATURE

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE.

"To the solid ground
Of Nature trusts the mind which builds for aye."—WORDSWORTH.

THURSDAY, NOVEMBER 5, 1903.

BLOOD AND IRON.

Plant Disease and its Relation to Animal Life. By E. F. Wright. Pp. vi + 160. (London: Swan Sonnenschein and Co., Ltd., 1903.) Price 3*s*. 6*d*.

THIS little book with so alluring a title is emphatically disappointing, and would appear to have been written by a compiler quite inadequately informed on the subject, especially in its botanical aspect.

The principal contention of the author seems to be that, because iron is necessary for the production of chlorophyll in the green plant, and is an indispensable ingredient in relation to the hæmoglobin of the blood in animals, these two bodies, chlorophyll and hæmoglobin, are the same. Thus on p. 1 we read, "Now what chlorophyll is to the plant, hæmoglobin is to the animal, the one being a red modification of the other," and, p. 69, "As hæmoglobin is allied to the proteids and a red modification of chlorophyll, it follows that the hæmoglobin of the animal varies as the chlorophyll or chlorophyll products vary in the plants eaten."

He then proceeds to argue that if an animal eats plants deficient in chlorophyll (*i.e.* chlorotic) it suffers the evils due to want of iron—*e.g.* (on p. 6) "animals eating chlorotic food must be deficient in sugar, fats and proteids," which would seem to indicate (since the author appears not to discriminate between chlorosis and etiolation) that people who are fond of cauliflowers, asparagus, endive, rhubarb, and the like, run risks hitherto unsuspected. For note this (p. 13), "if my contention is correct, the susceptibility to certain bacterial diseases is directly traceable to the use of chlorotic food." And on p. 15, "from which it follows that a chlorotic plant will contain less proteids than a plant containing the maximum quantity of iron." And, again, p. 28, "it is clear that there must be a large number of animals living entirely or partly on this chlorotic vegetable food, from which it follows that a large portion of animal life must be more or less anæmic through eating this chlorotic food."

We have already stated that the author draws no distinctions between different forms of chlorosis and etiolation, and puts the former down simply to a lack of iron. Now let us see what he regards as the measure of this deficiency, bearing in mind that modern plant physiology teaches us that the traces of iron found necessary to develop the peculiar form of chlorosis in question are so minute that it is often somewhat difficult to ensure the absence of that element in experimental cultures.

On p. 7 we read, "Yet there are many soils quite wanting in iron, and in the history of agriculture you never read of manuring with iron, excepting possibly in the case of some experimental plots, although some iron has been used of late years in the form of basic slag, which contains about 18 per cent. of iron," and, further on the same page, "Unfortunately, much vegetation is deficient in iron, and consequently chlorotic, and it would seem simpler instead of washing with sulphate of iron, as is now occasionally done, to have recourse to manuring the ground with iron," all of which goes to show that the author's notions as to the relations between iron and plants are, to say the least of it, crude. Does he seriously suppose that basic slag is used as manure on account of the iron it contains?

But lest there should be any risk of misunderstanding the author's meaning here, we may quote the following from this amusing book. After describing how one lamb of a flock, too weak to proceed, was rescued and brought up by the children of a blacksmith, the author continues (p. 34), "This lamb grew up by grazing on the grass growing round this [the blacksmith's] shop, and was shorn three times in three years," &c., and he explains the excellent condition of this lamb as follows:—"In the first place, it is quite certain there would be plenty of iron in the soil for some distance round a country blacksmith's shop, owing to rusty iron being carried about, to say nothing of the scales of iron and iron filings," &c.

To show what gourmands for iron the author's animals are, we quote from p. 93:—"And to show that

animals require iron, I have seen mules licking rusty iron, just as thousands of people have seen horses licking salt," to which valuable testimony he quotes an account of quails in Florida picking at the holes in the steel rails.

But to appreciate fully what a man of blood and iron we are concerned with, it is necessary to obtain some insight into his views of what his plants and animals do with these relatively enormous quantities of the metal.

We read on p. 5, "iron is the means of fixing the ammonia of the air in the soil to form nitrates. In any case I am sure there is a fixed law by which the ammonia of the air is fixed in the soil to form nitrates . . . ." Then, on p. 21, "it has been proved over and over again that iron is fatal to all fungi, consequently it is unreasonable to suggest that bacteria would attack a perfectly healthy animal, and destroy the blood containing a constituent which was a poison to them."

And, again, on pp. 98–99, "The distinct chemical difference between fungi and what we look upon as ordinary plants, is that the fungi contain no iron or nitrogen, while these constituents are essential to ordinary plant life. It is known that iron and nitrogen are fatal to fungi, therefore the more iron and nitrogen animal life takes up in its food the more likely it is to be immune to bacterial diseases."

It might not unreasonably be expected that we had here plumbed the depths, but the following shows that there are nether regions still, for on p. 42 we have the astounding statement, "It is fully recognised that iron and nitrogen in combination with the phosphates are the means by which the plant is enabled to take up the carbon of the air, . . ." and on p. 68, "it is admitted that the proteids are fatal to pathogenic bacteria." Even these are not the only contributions of the author to the study of bacteria, for he states (p. 98) "it is recognised that all classes of bacteria can only live on foods corresponding in chemical composition to themselves," which pronouncement would appear to require some explanation in view of the previous one regarding proteids, for instance, and the following, quoted from p. 33:—"it is admitted that pathogenic bacteria cannot live in the presence of proteids."

What the author's idea of a proteid may be we have been unable to make out, but there is no hesitation needed in regard to some of his notions regarding immunity, of which the following is a specimen (p. 60):—"Another important factor in immunity is electricity, which is so closely connected with the chemistry of the animal that it is reasonable to think that an animal of normal chemical combination will be in a position to produce much more electricity than an animal chemically deficient."

Immunity is a fascinating but a very difficult subject, but the author is not deterred by the latter in his submission to the former attribute.

On pp. 118–119 we read, "although Storer does speak of the better kinds of humus, yet it may be a chlorotic humus, or it may be a humus containing a maximum chlorophyll, or any variation between the two, which variation would be capable of constituting a great chemical difference." Indeed, we should think it would! But let us read on (p. 120), "if you have a field rich in all the essential mineral constituents, in an assimilable form, and a green crop be grown in this field and ploughed in, and then a cereal crop be grown, this cereal crop will be immune to rust, to say nothing of other parasitical diseases." Here it might be said that the author is merely claiming that high manuring renders a crop more immune, did not the context show that his ideas are by no means so simple, and if the continuation on p. 120 were overlooked, "while if in another field, very deficient in these assimilable mineral constituents, a green crop was grown of a chlorotic nature and ploughed in, then the cereal crop grown would not be immune owing to the imperfect chemical functions performed by what I may call a chlorotic humus."

And this, after all the careful work that has been done on the cereal rusts and other parasitic diseases!

On p. 131 the author declares that "parasitic fungi and bacteria can only flourish when the plant (or animal) on which they feed is deficient in chlorophyll or chlorophyll matter, or their products."

An interesting specimen of the author's quality appears in the following naïve passage on p. 148:—"Slugs, indeed, living as they do like the fungi mainly upon decaying vegetable matter, are not unlike creeping fungi, and I believe it can be shown that they are chemically of a similar composition." Again, p. 158:—"I have now pointed out that there are forms of insect life that are to all intents and purposes simply an extension of the fungi."

These suggestive quotations will, we are of opinion, convince the reader that the present volume cannot be said to be of any use to a serious student of science.

MINES AND MINERALS OF THE UNITED STATES.

Mineral Resources of the United States. Calendar Year 1901. Pp. 973 and index. (Washington: Government Printing Office, 1902.)

THIS is the eighteenth volume of the well-known series issued by the United States Geological Survey, and, like those which have gone before, it is full of valuable information concerning the mineral output not only of the country itself, but also of the world generally. The book consists of a number of articles written by various experts; thus the production of iron ore is dealt with by Mr. Birkinbine, and the American iron trade by Mr. Swank. Mr. G. F. Kunz contributes some interesting pages upon precious stones, whilst the coal trade is reviewed by Mr. E. W. Parker. The consequence is that a more useful contribution to knowledge is made by the United States Geological Survey than by the British Home Office in its annual mineral statistics.

The introductory remarks written by Dr. David T. Day tell us that the total value of the minerals produced in 1901 is reckoned at 1,086,529,521 dollars, or about 223 millions sterling; this is more than twice the value of the mineral output of the United Kingdom last year. It must be pointed out, however, that the

American figures are swollen by taking the value of the metals and not the value of the ores, but even if the comparison with this country were made upon strictly identical lines, we should still be a long way behind.

In 1901 the United States produced more coal, copper, gold, iron, lead, salt and silver than any other country in the world. The yield of coal was about one-third of the world's supply. This mineral is mined in twenty-eight different States, Pennsylvania being, of course, by far the most important. Twenty-four States are producing iron ore, Minnesota heading the list with 11 million tons of red hæmatite.

Montana yields about two-fifths of the copper of the United States, the Lake Superior district about one-quarter, and Arizona about one-fifth.

Colorado has outstripped California, and is now the leading gold-producing State.

Mr. Oliphant's chapter upon natural gas is sure to claim much attention, and is of special import for those who are interested in our new supply in Sussex. The advantages of this cheap and economical fuel are lauded to the skies by the author, who reckons that the quantity tapped and supplied in 1901 exceeded one cubic mile in volume; 21,848 miles of mains, 2 to 36 inches in diameter, are employed in distributing the gas to consumers.

We learn from Mr. Struthers that the United States are the largest producers of borates in the world. Most of the borax is obtained by treating the colemanite of California.

According to Mr. Joseph Hyde Pratt, who deals with abrasives, artificial corundum is now being employed in the manufacture of emery wheels. It appears that bauxite is converted into corundum by means of great heat and pressure in an electrical furnace. The mineral monazite is far more widely distributed than was imagined when its name was chosen in allusion to its supposed rare occurrence; it derives its commercial value from the small percentage of thoria which it contains. The quantity washed from gravels and sands in North and South Carolina in 1901 amounted to 334 tons.

In dealing with a great work like the volume under review, it may seem ungenerous to point out a small and trifling error, but probably Mr. Birkinbine will be glad to correct the statement that "no true manganese ore is won" in Great Britain. The Merionethshire ore cannot be fairly described as "manganiferous iron ore" when an analysis[1] shows 25 per cent. of manganese and only 4 per cent. of iron.

[1] Halse, "On the Occurrense of Manganese Ore in the Cambrian Rocks of Merionethshire." (*Proc.* N.E. Inst. M. and M. Eng., vol. xxxvi. 1887).

CLIMATOLOGY.

Handbook of Climatology. Part i. General Climatology. By Dr. Julius Hann. Translated by Robert de Courcy Ward. Pp. xv + 437. (London: Macmillan and Co., Ltd., 1903.) Price 12*s*. 6*d*. net.

THE translation into English of the first volume of Dr. Hann's "Climatologie" is a very welcome addition to the library of English-speaking meteorologists. The translation does not extend to the last two volumes of the original work, which deal with special climatology, as it has been found "impracticable" to translate them. This is greatly to be regretted, for the generalisations which constitute the science of climatology cannot be satisfactorily treated without reference to the statistical data and the means for verifying them. Moreover, a compendious review, in English, of the statistics of the various meteorological elements arranged according to geographical distribution is constantly wanted for many purposes, and either a translation of Dr. Hann's volumes, or a reproduction in an abridged form of Dr. Buchan's volume of the *Challenger* reports, is a necessity of which every student of meteorology must be aware. It is quite true that such a survey would be a work of reference, and would not serve as a text-book in a course of general climatology, and as that is Prof. Ward's purpose in preparing the translation, we must unfortunately wait for some other interest to prompt the translation of the two volumes of special climatology.

The translator himself explains the relation of the English version to Hann's first volume:—

"This translation, as it stands, essentially reproduces the original. Numerous references, especially such as will be most useful to English and American students, have been added, and changes have been made in the text in order to bring the discussion down to date. A natural temptation to expand the original has been yielded to in very few cases only. Practically all of the important publications which have been issued since the completion of the second German edition are referred to. Some new examples of different climatic phenomena have been added, chiefly from the United States. Most of the examples given, however, necessarily still relate to Europe, because the climatology of that continent has been studied more critically than that of any other region. A few cuts have been made where the discussion concerned matters of special interest to European students only."

Among recent works, references to which have been incorporated, Bartholomew's "Atlas" is conspicuous, but the remarkable Russian "Climatological Atlas," published in 1900, is not, although it furnishes a large number of illustrations of climatological principles.

A distinction is drawn by Hann between climatology and meteorology, but when one deals with general climatology it is rather hard to maintain the distinction. In dealing with the analysis of climates into solar, or mathematical climate, and physical climate, with such subdivisions as mountain climate, continental and marine climates, forest climate, and such supplements as mountains as climatic barriers, geological changes of climate and periodic variations of climate, all of which are treated in the book, it is obvious that neither author nor translator would be content with the mere analysis of figures representing these different sections. The mode of classification at once suggests the causes of climate, and the investigation of such causes is practically general meteorology.

It is scarcely necessary to refer to the admirable way in which Dr. Hann arranged his introductory volume to include a survey of all the general facts about climate and its local variations, and to produce a book

which always surprises those who take it up by the fulness of its information and by the interest which it stimulates. There is no specific indication in the present volume as to what parts are derived from the original and what parts are due to Prof. Ward's careful editing; in any case, the result of the collaboration is a most admirable book.

W. N. Shaw.

OUR BOOK SHELF.

The Steam Turbine. By Robert M. Neilson. Second Edition. Pp. xvii + 294. (London: Longmans, Green and Co.) Price 10*s.* 6*d.* net.

The history of the steam turbine previous to the reign of Parsons, whose first patents were applied for in 1884, may be made out from chapters i. and ii. But descriptions of inventions in the language and with the illustrations usual in patent specifications are not quite what is expected from the author of such a book as this. There is an appendix giving the names and dates of all patents relating to steam turbines. The history and construction of the Parsons and the Laval turbines are given at some length, with the results of practical tests for power and consumption of steam, and the reader gets an opportunity of understanding the construction of modified forms which are now, under various names, coming into use. Students are anxious to examine good drawings and descriptions of the details of the Parsons turbine, and it would appear that these are difficult to obtain. The author of this book has given much information and many illustrations somewhat in the style made familiar to us in the engineering newspapers. Much more information is given about the Laval type of turbine. As to the theory of these turbines, the essentially important points seem to be ignored, and yet all the theory of any turbine known to anybody may be given very shortly indeed. There is a particularly interesting point in connection with the Laval turbine to which the author might have directed attention, namely, the exceedingly great speed reached by fluid at the end of an expanding mouthpiece. So far as we know, the reason for this has never been published, and yet any student of the papers of Osborne Reynolds ought to be able to give it readily.

The chapter on the propulsion of ships by turbines is interesting.

On the whole, the book is one that ought to be read by students; it is practically the only book on the subject, but we think that the author has not done so well with his materials as he might have done.

Whittaker's Electrical Engineer's Pocket Book. Edited by Kenelm Edgcumbe. Pp. viii + 456. (London: Whittaker and Co., 1903.) Price 3*s.* 6*d.*

This little book differs in several respects from the ordinary type of pocket book; it possesses the usual features—a limp cover, round corners, gilt edges, and a weight quite unsuited to the pocket—which serve to characterise the "pocket book," but in the arrangement of the matter it rather resembles a small encyclopædia. Each branch of electrical engineering is dealt with in a separate section or chapter, which may be read consecutively as if it were a brief treatise on the subject. The method has much to recommend it; the electrical engineer who comes across some problem in a branch with which he is not familiar can turn up the section dealing with that branch and read a summary of the whole subject; numerous references to recent papers will greatly help him in finding the particulars which he wants. There are, of course, also a number of tables of the constants more generally required. The treatment is not very even; thus whilst generating machinery—dynamos, alternators, and motors—receives full consideration in 100 pages or more, only four pages are given to electric lamps and lighting, and the information given therein is quite inadequate. The diagrams and illustrations are clearer than those usually to be found in books of this class.

M. S.

Astronomischer Jahresbericht. By Walter F. Wislicenus. Band iv. Pp. xxxii + 648. (Berlin: Georg Reimer, 1903.)

This, the fourth issue of this most valuable and useful volume, contains the references and a brief summary of contents of the astronomical literature published last year. The work is of the same high standard as in former years, and casts great credit on the labours of Herr Wislicenus and his joint compilers. This year-book is so well known to astronomers, and has been found so valuable by them, that it is hardly necessary to dwell either on the general arrangement of the subject or on the method of treatment. The main object of the compilers was to make as perfect a record as possible of all the published papers on this subject, yet to keep the book from becoming too bulky. This they have succeeded in doing, in spite of the fact that many of the abstracts of lengthy papers are very complete.

Now that the Royal Society has published the first annual issue of this branch of science (E. Astronomy) in the "International Catalogue of Scientific Literature," it seems possible that there will scarcely be room for both of these compilations, since the more perfect they become the more closely will they resemble each other. This question, however, the future will no doubt settle. There is, nevertheless, one main difference between them, in that the volume before us summarises the contents of each paper to which reference is made, while that of the "International Catalogue" is restricted to the bare references.

W. J. S. L.

Practical Management of Pure Yeast. By Alfred Jörgensen. Translated by R. Grey. Pp. viii + 60. (London: the *Brewing Trade Review*, 1903.)

This useful little work might have received with advantage a title better descriptive of its contents. It contains a condensed account of the biological methods which are employed in the author's well-known laboratory in the pure culture and analysis of alcohol-producing yeasts. According to the preface, the leading purpose of this treatise is to enlighten the so-called practical man in the methods of investigation employed by the zymotechnologist, so that in the future the practical man and the technologist may work together with better understanding at the many important and difficult problems which are encountered in the processes of the fermentation industries. No doubt the little book is well calculated to fulfil its object if only the practical man will read it, and we hope it will be in much demand for this purpose. But whatever may be the success of the book in this direction, it undoubtedly deserves the careful attention of all zymotechnologists, as it indicates the lines on which a well-known investigator of great experience is working with a view to the solution of many interesting and complicated problems in connection with the organisms of fermentation. The last words on the biological methods of analysis and the technical employment of pure cultures of yeast are still a very long way from being spoken, but as an advance towards this end we cordially recommend the work to the attention of all interested in the biological aspect of the fermentation industries.

A. J. B.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Variation of Atmospheric Absorption.

I SHOULD be pleased to know how far some observations on the change in the average absorption of the terrestrial atmosphere in this country during the last two years have been confirmed by observations elsewhere. The following table gives the mean of the best of these, made at Washington in the autumn of 1901, the spring and autumn of 1902, and in the winter, spring, and summer of 1903.

Coefficients of Transmission for Zenith Sun.

	μ	μ	μ	μ	μ	μ	μ	μ
Wave-length... ...	0·50	0·60	0·70	0·80	0·90	1·00	1·20	1·60
Mean of observations, 1901–1902.	0·765	0·769	0·857	0·897	0·910	0·921	0·933	0·930
Mean of observations during 1903	0·627	0·692	0·753	0·797	0·825	0·847	0·874	0·909
Excess of transmissibility of 1901–1902 over that of 1903	20%	10%	13%	12%	10%	8·4%	6·5%	2·3%

The decrease in the transmissibility of the air this year as compared with the last is so marked that some local effect on climate and vegetable growth might seem to be probable. Whether the unusual coolness of the summer, reported both in America and abroad, is connected with it may be a subject for speculation. S. P. LANGLEY.

Smithsonian Institution, Washington, October 22.

Heating Effect of the Radium Emanation.

THE very important and fundamental experiments described by Profs. E. Rutherford and H. T. Barnes in NATURE of October 29 will have been read with the greatest interest. Owing to the importance of the subject, I should like to direct the authors' attention to some points in their comment and explanation which do not appear to me to be quite clear, and if I can draw from them some more detailed discussion this letter will have served its purpose.

The general conclusion arrived at by the authors is that "more than two-thirds of the heating effect is not due to the radium at all, but to the radio-active emanation which it produces from itself." If I understand the description of their experiments correctly, these seem to me, however, to point to the fact that it is the "excited activity" and not the emanation that is the cause of the heating. Apparently de-emanated radium gives out an amount of heat at a rate which falls in a few hours to a minimum and then slowly recovers. Now the emanation itself begins to form again at once, so that on the authors' hypothesis the heating effect should start with a minimum and then gradually increase. The activity of the radium measured by electric methods follows the course of the heating effect, and, as Messrs. Rutherford and Soddy have explained (*Phil. Mag.*, April, *not* May as quoted by the authors), this is due to the fact that the de-emanated radium has still the excited activity attached to it, and this activity decays in the course of a few hours. When the excited activity is gone there is nothing but radium left, and the further changes are due to the re-formation of the emanation and its subsequent change into excited activity. During the course of the first few hours there is, therefore, very little emanation, but there is excited activity which falls to a minimum and then slowly grows again. Does not the explanation which holds for the activity also hold for the heating effect, and would it not follow that the parallelism of heating effect lies with the amount of the excited activity present, and should be assigned to it rather than to the emanation?

Similarly, the emanation, according to the authors, does not give its full heating power at first, but the heating effect rises to a maximum in the course of the first few hours. If the emanation is the cause of the heat, why this slow rise? Here again the effect seems proportional to the amount of excited activity present, and not to the amount of the emanation. The connection of heating power with the emission of α rays also requires further elucidation, and the information given by the authors is not, I believe, sufficient to prove their case. It is only with great diffidence that I address these remarks to you, because Prof. Rutherford knows the whole subject at first hand, and his judgment is more likely to be correct than mine. Nevertheless, one likes to know whether others have felt the same difficulty, and whether the apparent disagreement is one of misunderstanding or has some more deep-seated cause. ARTHUR SCHUSTER.

The Owens College, Manchester, November 2.

Radium and Plants.

THE sensibility of protoplasm towards the radiations of radium is a matter of so much importance that a few preliminary experiments I have carried out on plants may be of interest.

The first experiment I made in this direction was with cress seedlings. About 100 seeds were uniformly distributed over the surface of some moist sand contained in a flower saucer, and a tube containing 5 mgrs. of pure radium bromide supported at a height of 1 cm. over the centre of the sand surface. During the experiment the saucer, covered with a glass shade, was kept in the dark. It was hoped that this arrangement would show whether the radiations are harmful or not to the sensitive cells of seedlings, and at the same time indicate if they are able to act as a stimulus to evoke positive or negative curvatures.

After the germination of the seeds, which took place within two days nearly simultaneously all over the sand, the growth of all the seedlings was nearly uniform. But close comparison showed that the seedlings immediately under the radium tube were to some small extent retarded in their development. The retardation was apparent in the seedlings situated within a radius of about 2 cm. from the radium bromide. Besides being smaller, these seedlings developed somewhat fewer and shorter root-hairs than those nearer the margin of the sand.

In the subsequent growth the presence of the radium evoked no curvatures in the little plants close by it, or in those more removed. Nor did it appear to exercise any noxious effects, other than the retardation just described, on the seedlings within the period of the experiment, viz. thirteen days. The plants grew up beside it and against the glass containing it, neither influenced by it nor hurt by it, so far as one could see.

This experiment was repeated on two other occasions (one experiment lasting three days after germination and the other lasting four days) with the same result, viz. no curvature was evoked, but the seedlings close under the radium bromide were slightly retarded in their growth.

In order to determine if motile organisms are sensitive to the radiations I enclosed the radium tube in a vessel of water containing large quantities of *Volvox globator.* Extraneous light was cut off from the experiment. After twenty hours many of the Volvox colonies had sunk to the bottom of the vessel, but they were evenly distributed over the bottom, and were neither aggregated under the tube nor dispersed away from it. Those that were still swimming in the water were also uniformly distributed through it, some actually in contact with the radium tube and some far away from it, but showing no sign of being attracted towards it, or of being repelled from it.

It is apparent from these few experiments that the radiations emitted by radium bromide are not able to produce marked effects in a short time on these vegetable cells and tissues. Even the phosphorescent light (which is quite perceptible to the eye under suitable conditions) emitted by the radium bromide is too feeble to be effective in calling out a phototactic response. HENRY H. DIXON.

Botanical Laboratory, Trinity College, Dublin.

Solar and Magnetic Disturbances.

THE Kew photographic curves showed appreciable magnetic disturbances of a normal type on the evening of October 30 and early morning of October 31, but the first distinct precursor of the magnetic storm was an exceptionally sudden movement at about 6h. 3m. a.m. on October 31, shown alike in the declination, horizontal force and vertical force curves. This movement was largest in the horizontal force, where there was a sudden increase of about 60 γ ($1\ \gamma \equiv 1 \times 10^{-5}$ C.G.S. unit). In the declination there was a simultaneous movement of about 7′ to the west, apparently preceded by a very tiny movement to the east, lasting too short a time to be distinctly shown. The first large movements commenced about 6.45 a.m., when there was a movement of the declination needle to the west through about 34′, and a diminution of 240 γ in the horizontal force. The storm was most violent between 10 a.m. and 7 p.m. on October 31, but there was a large amount of disturbance until 3 or 4 a.m. on November 1.

The traces from the Kew magnetographs—declination, horizontal force and vertical force alike—went off the sheet repeatedly, so that the full extent of the disturbance cannot be derived from them. A declination magnetograph, however, of lesser sensitiveness recorded apparently the complete movement, and showed a range of about 2° 12′. Between 1 and 7 p.m. there were at least twenty to and fro oscillations of the declination needle—each occurring in but a few minutes of time—the amplitude of which exceeded 20′. In addition to these there was a very large number of smaller oscillations. At times these followed one another so rapidly that they can hardly be seen apart on the photographic sheet. In the horizontal force there were also very numerous oscillations. The general tendency from 7 a.m. to 10.30 a.m. was towards a reduction of the force. From 10.30 a.m. to 1 p.m. the oscillations were about a value not far from the normal. At about 1 p.m. there commenced a rapid rise, which in twenty minutes amounted to about 690 γ, the curve going off the sheet. During the next two and a half hours the trace was often off the sheet. Between 3.50 and 5.10 p.m. the trace crossed the sheet from edge to edge, representing a change of about 750 γ, or somewhat more than one twenty-fifth of the value of the whole horizontal force. The vertical force disturbance was small at first, and did not become really large until nearly noon on October 31. From noon to 7 p.m. there were numerous large oscillations, the curve going off the sheet repeatedly on one side. At about 1.40 p.m. there was an oscillation where, in the course of five or six minutes, there was a decrease and increase of more than 350 γ. The trace remained off the sheet from about 3.30 to 5 p.m. Between 5.10 and 5.50 p.m. the force diminished about 450 γ.

The storm is much the most notable recorded at Kew since February 13–14, 1892. CHARLES CHREE.

National Physical Laboratory, Richmond, Surrey, November 3.

IN connection with the magnetic storm of Saturday last, October 31, it may be of interest to record that observations made between 10 and 11 a.m. on that day by Prof. Callendar and myself showed a violent distortion and reversal of the C line of hydrogen in the neighbourhood of the great sunspot group, which was then a little past the central meridian. A notable feature was the apparent detachment of a portion of the dark C line, the separated part presenting the appearance of a cloudy patch, displaced towards the violet by about three tenth-metres. The observations were unfortunately interrupted by clouds.

A reversal of the C line over the same spot had been observed on the two preceding days, but though on these occasions the bright line was more brilliant than on October 31 there was much less distortion of the dark line.

A. FOWLER.

Royal College of Science, South Kensington, November 3.

Dr. Shaw's Address at the British Association.

I HAVE received the following letter from Sir Arthur Mitchell, K.C.B., who has been for long closely identified with the Scottish Meteorological Society, both as a scientific worker and as an administrator, and who was one of the founders of the Ben Nevis Observatory, and I send it to you as it expresses what I am sure must have been the feeling of meteorologists on reading Dr. Shaw's otherwise admirable and inspiring address on methods of meteorological investigation.

34 Drummond Place,
Edinburgh,
October 15.

Dear Mr. Omond,—

Dr. Shaw's address to the subsection of astronomy and meteorology of the British Association in September last, by its appearance in NATURE of September 17 has quickly and effectively reached the whole scientific world, and it is misleading in important directions, quite unintentionally, I believe.

The absence of all reference to the meteorological work done by Buchan, Stevenson, Aitken, Buchanan, Murray, yourself and others will probably receive an interpretation which I hope is erroneous, for I cannot think that Dr. Shaw would designedly belittle the valuable work these men have done, which is recognised as being of a high character all over the world.

But it seems to me more remarkable that Dr. Shaw should have made no special reference to the work of the Ben Nevis Observatories. In that work a very great, costly and laborious effort has been made to advance meteorology and to add to knowledge, and this has been done mainly through private enterprise, under the guidance of the foremost scientific men of our time, including Kelvin, Tait, Buchan, Murray, Copeland, Aitken, Buchanan, Stevenson, and many others. The discussion of the outcome of this great experiment in connection with the physics of the atmosphere has only recently begun. It cannot be quickly finished, much time by many experts must be given to it, and it cannot fail to cost a large amount of money.

My special object in writing to you is to suggest that, as honorary secretary of the Ben Nevis directors, you should in some way supply what I regard as an incompleteness in Dr. Shaw's address by briefly stating how the work of the Ben Nevis Observatories now stands, and what prospects there are of its yielding further important additions to knowledge.

Very faithfully yours,
ARTHUR MITCHELL.

In accordance with Sir Arthur's suggestion I beg to make the following statement explanatory of the present position of the Ben Nevis Observatories, and to note briefly the work carried on at and in connection with these observatories.

When the observatory on Ben Nevis was opened twenty years ago very little was known about the condition of the atmosphere above a few hundred feet height over the British Islands. The first object aimed at was to determine the meteorological constants for that position, and the relations of the air there to that at sea-level in the neighbourhood. This latter part of the work has only been adequately carried out since the establishment of the Fort William Observatory in 1890. The observations down to the end of 1892 have been published in two volumes of the *Transactions* of the Royal Society of Edinburgh (Nos. 34 and 42). The first of these was printed at the expense of the Royal Society of Edinburgh, and the second at the joint cost of the Royal Societies of London and Edinburgh. Another volume is in the press, and will be issued shortly.

The constants referred to are:—(1) The average value at each hour of the day for each month of the year of barometric pressure, temperature of the air, humidity, rainfall, direction and force of wind, amount of cloud and sunshine on Ben Nevis. (2) The relation of each of these to the corresponding sea-level values at Fort William. Immediately arising from these average values is the question of the changes induced on them, especially on the second series, by different conditions of weather—that is, the determination of the vertical gradients of pressure, temperature, &c., under varying atmospheric conditions. This discussion has been partly carried out, and the more important results arrived at are summarised in papers appended to the two volumes of observations.

One of the most interesting practical aspects of the Ben Nevis records is their application to the reduction of barometric readings to sea-level, a subject which is at present engaging great attention in this country, in the United

States, and, indeed, wherever meteorology is studied. The other subjects treated in these papers include:—

(1) The changes in the hourly variation of the barometer in fine and in cloudy weather at Ben Nevis, Fort William, and several other stations.

(2) The general meteorological conditions on Ben Nevis in clear and in foggy weather.

(3) Atmospheric dust on Ben Nevis.

(4) The pumping effect on a barometer of strong winds.

(5) The difference in the direction of the wind at Ben Nevis from that at sea-level.

(6) The change of temperature with height in anti-cyclones.

(7) The diurnal ranges of the Ben Nevis and Fort William barometers when both are reduced to sea-level by the usual tables.

(8) The diurnal range of the variability of temperature from day to day at Ben Nevis and some other places.

(9) The meteorological conditions at Ben Nevis during the severe frost of January and February, 1895.

(10) The relation of wind direction to temperature and to rainfall at Ben Nevis.

The establishment of the Ben Nevis Observatories has provided meteorological data of a character unique in this country, and, indeed, in the world, owing to the position of Ben Nevis as a high-level station placed right in one of the storm-tracks of the Atlantic. But it has also led to investigations which could not otherwise have been carried out, for no increase in the amount or quality of low-level observations would have supplied the necessary data, and the high-level records got from kites or balloons are too fragmentary for the purpose.

The observatories were built with money subscribed by the public, and up to this time have been supported by subscriptions, aided by an annual payment of 100*l.* for the Ben Nevis Observatory and 250*l.* for the Fort William Observatory from the Parliamentary grant of 15,300*l.* given annually for meteorological purposes. What their future position may be depends on the recommendations of the Parliamentary Committee of Inquiry into the administration of this grant now sitting, but whether Parliament gives the money necessary to carry them on, or whether they are closed and abandoned, as they assuredly will be if not taken over by the State, the work done at and in connection with these observatories is a record of investigation which will be growingly studied by meteorologists.

Edinburgh, October 17. R. T. OMOND.

No one is more conscious of the shortcomings and omissions of the address than its author. One correction I should like to make here. The joint editors of the *Meteorologische Zeitschrift* are Dr. Hann and Dr. Hellmann; Dr. Pernter is associated with the journal as "Herausgeber."

I cannot fail to be aware that, with perfect propriety, I might have devoted a large part, or even the whole, of the address to the obligations of meteorology to private enterprise in this country. In that case it would have been a different, perhaps a better, address, but I will ask your readers to believe that any omissions of that kind which they detect and regret were not due to a desire to belittle anything except the address itself.

In one sentence I did explicitly refer to Edinburgh and Ben Nevis. I cannot altogether emulate the achievement of Mr. Puff, who managed to extract so much meaning from a shake of Lord Burleigh's head, but I should like to say that if Sir Arthur Mitchell had used an appropriate magnifying power, and had got it properly focused upon that sentence, he would have read the following opinion which the mention of Ben Nevis always suggests to my mind, "that if means were found for endowing a chair of meteorology in the University of Edinburgh, and one of the distinguished Scottish meteorologists, whose names require no announcement from the chair to make them known to the British Association and far beyond, were appointed thereto, a most important and productive step would be taken towards the solution of the many problems connected with the great Scottish work of the Ben Nevis Observatories, the twenty-first annual report of which Dr. Buchan will present to the Association." W. N. SHAW.

October 21.

Weather Changes and the Appearance of Scum on Ponds.

IF any of your readers could explain an interesting natural phenomenon constantly occurring here we should be very grateful. It is simply that, invariably before any decided change of weather, there comes up a scum on the surface of the pool or small lake which skirts our south and east lawns—part of the pleasure grounds surrounding the mansion. Sometimes it looks like soapy water, but at other times it is black, and makes the breasts of our swans as black as ink just above the water-line. Then the scum will suddenly disappear, and the swans' breasts become white again. Our geological formation is the junction of the Upper Greensand and the Lower Chalk. The bottom of our lake is chalk; it is fed by springs, and the stream formed by its overflow runs finally into the Thames. It is shallow, and is surrounded by large trees. There are at present eight swans on it, also many moorhens and wild duck, and quantities of fish, which attract herons; kingfishers live in the bank, which is very high on the far side. There is also an island with large trees and a dense undergrowth. PLATANUS ORIENTALIS.

Aston Rowant, Oxon.

WITH reference to the letter of "Platanus orientalis," it seems to me that a possible explanation of the appearance of dirty scum on the surface of the pond before any decided change of weather may be that a sudden change of barometric pressure may accelerate the flow of springs rising through the chalk of the floor of the pond. This would carry up to the surface of the water some of the fine mud which had rested on the chalk, or even lodged in crevices within it. When the flow of the springs diminished or ceased, the sediment would naturally subside once more. It would be interesting to keep an exact record of the appearance of the scum and of the variations of atmospheric temperature, pressure, and the rainfall by automatic recording instruments.

Without knowing the local conditions it would be impossible to speak definitely as to the sufficiency of this explanation.

Another that occurs to me is that, if the sediment at the bottom of the pond is of a flocculent character, its movements may be due to the same cause as those of the precipitate in a "storm-glass," whatever that cause may be; but in that case the appearance would probably be limited to dead calm weather.

It is possible that the scum may be organic, and it would be desirable to have it examined microscopically by a student of limno-plankton.

HUGH ROBERT MILL.

Cranial Casts.

IN the number of NATURE which arrived here to-day there is a report of the interesting presidential address delivered by Prof. Symington in Section H at the British Association's recent meeting. In this report there are several statements which are likely to prove misleading to those who are not familiar with the literature relating to brain-casts. The reader might imagine (see p. 540) that this was an entirely new branch of research suggested by Dr. Forsyth Major's work on the subfossil Lemuroids (1898) and only fully exploited by Prof. Schwalbe in 1902. This, of course, cannot be the meaning which Prof. Symington intended to convey, because he is quite familiar with the scores of cranial casts made in such profusion by Prof. Gervais in the years 1867–1871, and by a long line of anatomists and palæontologists both before and since that time, and with the valuable contributions to knowledge which have resulted from this fertile branch of study; in fact, Prof. Symington happened to visit the work-room in the Royal College of Surgeons in 1901 when I was examining and describing the considerable collection of such casts (representing more than one hundred genera) which have been brought together by the late Sir William Flower and the present conservator, Prof. C. Stewart. (And, with reference to Prof. Symington's remarks on curators, I may mention that no one more fully recognises the value of cranial casts than the present conservator of the Royal College of Surgeons' Museum.)

But more remarkable than this is the statement :—"This method has been applied with marked success to the determination of the characters of the brain in various fossil lemurs by Dr. Forsyth Major and Prof. R. Burckhardt" (p. 540). The "*marked success*" of Prof. Burckhardt consisted in flatly contradicting in almost every essential feature the *correct* account of the same specimen given by Dr. F. Major, as I have pointed out in a work (*Trans.* Linnean Soc., February, see especially p. 365) published seven months ago. Prof. Symington could not have chosen out of the scores of memoirs on cranial casts an example more likely to bring contempt on the method he so eloquently and so justly extols.

His statement that "so far as prehistoric man is concerned, we can never hope to have any direct evidence of the condition" of the brain is stultified by the fact (which I mentioned fifteen months ago in the *Journ. of Anat. and Phys.*, July, 1902) that I have in my possession a large series of actual prehistoric brains with the crania from which they were derived. Many of these are so excellently preserved that every detail of the convolutionary pattern can be recognised, and by transferring it to the surface of the cranial cast an accurate model showing exactly the size, shape, and arrangement of the sulci with perfect accuracy can be obtained. That I am not exaggerating the excellence of these prehistoric relics may be seen from the brain fragment (D. 691) in the galleries of the Royal College of Surgeons' Museum, especially when I add that I possess whole hemispheres in even a better state of preservation.

As to the method of interpreting human brain casts, if we follow Prof. Symington's advice and begin by identifying the Sylvian fissure as the groove produced by the orbito-sphenoid ("as is well known, the marked prominence at the base of the human skull separating the anterior from the middle fossa fits into the deep cleft between the frontal and temporal lobes of the brain") we shall fall into grave error in many cases. It sometimes happens (in more than 50 per cent. of my collection of "Greek" and "Turkish" hemispheres) that the orbito-sphenoid lies far in front of (and not *in*) the Sylvian fissure, mapping out a great "post-orbital limbus" (Spitzka) of the frontal lobe, which has slipped over into the middle cranial fossa. I have seen the Sylvian fissure lying as far as 1 cm. behind the orbito-sphenoid (in a Syrian brain), and a prominent crest derived from the alisphenoid projecting into it.

It is surprising to find Prof. Symington repeating that time-worn fallacy :—the inferior frontal convolution "is well known to be much more highly developed in man than in the anthropoid apes" (p. 541). For if we follow the lead of Profs. Marchand and Cunningham—and to anyone who really examines the facts of the case there is no other alternative—the inferior frontal sulcus is represented in the apes by the sulcus rectus, and the inferior frontal convolution is *relatively much bigger* in the apes than in man.

Every anthropologist will cordially re-echo Prof. Symington's wish that information concerning large series of non-European brains may soon be forthcoming. But that we know so little concerning these other types of the human brain is not wholly the fault of the people who have access to such material. The chief blame must rest on those anatomists who, with every advantage which museums, libraries, and trained assistants confer, have done so little to provide data relating to the European types of brain which are of any anthropological value. I know several anatomists in various parts of the world who have the material and are merely awaiting a "lead" as to which features of the brain are of anthropological importance and are worthy of being recorded.

I have recently met with the same difficulty. After having examined six hundred Egyptian, Soudanese, and a varied assortment of other non-European brains, I am unable to acquire from the writings of European anatomists just that information of the European types of brain which I need for purposes of comparison; moreover, I am unable to publish the anthropological results of my work in any satisfactory form until I have discussed such purely morphological questions as the real constitution of the fissure of Sylvius and have unravelled the intricacies of the parieto-occipital regions of the brain. When the "home" anatomists have done their part of the work, the rest will soon follow.

G. ELLIOT SMITH.

The School of Medicine, Cairo, October 7.

I HAVE to thank you for your courtesy in allowing me the opportunity of reading a letter which Prof. G. Elliot Smith has addressed to you, criticising various statements in my presidential address in Section H of the British Association at Southport. Prof. Smith has raised so many points that I have only time, at present, to reply to a few of them.

What a reader "might imagine" I will not attempt to picture, but I certainly had no intention of implying that only the three investigators I happened to mention had worked at the subject of cranial casts, or that "it was an entirely new branch of research."

I endeavoured to show that the examination of a skull was necessarily incomplete until the interior of its cranial cavity was exposed and cast, and that, although such methods were calculated to afford valuable information as to the relation between the external and internal surfaces of the cranial wall, and to give an important indication of the form of the brain it once contained, yet the curators of museums appeared to have an invincible objection to making the necessary section, and the practice of taking casts of the cranial cavity had been too much neglected by craniologists. I gave as an illustration of the usual custom of preserving skulls entire the Hunterian Museum in London, and this selection appears to have been a source of offence to Prof. Smith, although he does not disprove my statement. His remarks as to the number of casts of different genera in that museum are quite beside the mark. I was referring to the very large collection of human skulls, and, so far as I have been able to ascertain, no systematic attempt has been made to examine more than a small fraction of them in this way. I know that many curators object strongly to the skulls under their care being bisected, and believe that at any rate their appearance would be seriously affected by such an operation. I ventured to advocate a method which, in my opinion, has not been followed to any marked extent in the collection of human crania in the Hunterian Museum or elsewhere in this country, and trust I was at liberty to do this without it being regarded as a personal attack upon the conservator, for whom I have the very highest regard.

Prof. Smith objects to my statement that "we can never hope to have any direct evidence of the condition of the higher nerve centres of prehistoric man" on the ground that he has collected a large series of such brains from Egyptian cemeteries, and he refers to a paper he published in the *Journal of Anatomy and Physiology* last year. I had the pleasure of reading his paper when it appeared, and although his specimens were of great interest, it seemed to me that their state of preservation was not sufficiently good to be of much use for the accurate determination of the numerous details which it would be necessary to know, when comparing them with modern brains. The specimens had undergone marked diminution in size, and in places were considerably distorted. Further, from the actual photographs (Plate xiv.) which he gave it appeared to me that a considerable restoration would be needed when attempting to limit the boundaries of the cerebral fissures. I hope that the impression left upon my mind from the perusal of his paper may be an erroneous one, and that the additional evidence promised by Prof. Smith will dissipate my doubts.

I do not quite appreciate the cautiousness of those anatomists who are waiting for a "lead" before describing the specimens of non-European brains in their possession. The numerous memoirs that have been hitherto published on the cerebral convolutions are based almost entirely upon the study of European brains, and what we obviously require is a careful and an unbiased account of the cerebral fissures and convolutions of other races. If Prof. Smith and his friends wait until the favoured "home" anatomists agree as to the "types" of European brains, and until he has definitely settled for us all the morphological problems connected with the cerebral cortex, we shall, I fear, need a large store of patience.

In conclusion, I should like to assure Prof. Smith that if I did not refer specially to his work it was not because I do not appreciate its value, but on account of the limitations in time and space necessary in the circumstances of my address.

J. SYMINGTON.

October 19.

MAGNETIC STORMS, AURORÆ AND SOLAR PHENOMENA.

The attention of the whole civilised world has this year been directed to the importance of finding a connection between terrestrial and solar variations, but the phenomena recorded last Saturday in the nature of a great magnetic storm and a brilliant aurora borealis have perhaps brought home to many the desirability of pursuing such investigations which may help us to be forewarned, and therefore forearmed.

The enormous development of the telegraph, telephone, cable, and other applications of electricity since the date of the last great magnetic storm has caused the disturbance to be more generally observed than was previously perhaps the case.

Practically the world's whole telegraph system was upset, and information from this country, France, the United States and other lands shows that for several hours communication was almost completely interrupted.

According to the *Daily Mail* the London telegraphic department characterised the storm as the most extraordinary ever experienced. Messages dispatched on Saturday from Russia, Spain, Switzerland, France, Germany, Belgium, and other countries, which would ordinarily have been received an hour or less after transmission, were still slowly coming through on Sunday morning. Mr. Gavey, the electrician-in-chief to the Post Office, in an interview with a *St. James's Gazette* representative, said the storm was the most severe that had been experienced for the last twelve years. The effects of it were first felt at St. Martin's-le-Grand at 6.45 a.m. on Saturday, and they continued until five in the afternoon. It was eight o'clock before the storm had completely disappeared.

The New York correspondent of the *Daily Telegraph* states that the magnetic disturbance was felt practically everywhere in the United States, affecting the great cable companies for a time, while the telegraph wires in all directions from Chicago felt the effect; the long distance telephones were similarly troubled. The disturbance lasted eight hours, and at its climax "there were 675 volts of electricity—enough to kill a man—in the wires, without any batteries being connected to them." During the magnetic storm which occurred in 1871 the Eastern Telegraph Company showed that there was an earth current of 170 volts on their Suez-Aden line.

The *Times* correspondent in Paris states that according to a Press communication from the French Under-Secretary of State for Posts and Telegraphs the magnetic phenomenon extended in all directions, but with somewhat less intensity towards the north-west; the telegraph office was from nine o'clock in the morning deprived of communication with the greater part of the French towns and the adjoining districts. It was subsequently also cut off from communication with America, Spain, Portugal, Italy, Algeria, Tunis, and places beyond those countries. At 4.40 p.m. communication was re-established; it was again interrupted at 5.30 p.m., but a little after sunset almost all communications were found to be restored.

It is interesting to note that the effect of a magnetic storm on a telegraphic system may be modified in two, if not more, ways, and this was done in the case of our own Post Office. One method, as stated by Mr. Gavey, is to join two wires, thus forming a loop, and in this way eliminate the earth from the circuit. The other means is to employ condensers; these, when connected up with the circuit, stop a continuous current such as is set up by magnetic disturbances.

In several regions the magnetic disturbance was accompanied by a display of the aurora. In New York on Saturday morning the northern sky was described as "a dazzling display of light and colour"; it was first seen in the city at two o'clock, but faded away at four. In Ireland and Scotland during Saturday evening the aurora was also observed.

A message from the Sydney correspondent of the *Times* states that a beautiful Aurora Australis was seen there on Saturday night, the streamers reaching nearly to the zenith.

Earthquakes also seem to have been recorded as well. On Friday and Saturday two undulating shocks were felt at Benevento and Avellino, in Italy, the first lasting two seconds, and the other a minute.

In Essex several distinct earthquake shocks were felt at Saffron Walden. At midnight on Saturday one shock is stated to have lasted five minutes. These were repeated at 5.50 and 9.30 on Sunday morning. At Debenham, four miles distant, shocks were felt on Monday sufficiently strong to cause small articles to fall to the ground.

Tuesday's *Daily Mail* publishes a telegram from Simla (dated November 2) in which it is stated that terrible earthquakes occurred at Turshiz, near Turbati-haideri, in Persia. Unfortunately, the time of occurrence was not mentioned, and up to the moment of writing (Tuesday evening) the news has not been corroborated.

In a communication to the writer from Stonyhurst Father Cortie writes:—"We had a magnificent magnetic storm on Saturday and Sunday, the biggest ever recorded here. The declination magnet swung through 2° 46′. The spot of light for the horizontal force travelled several times right off the pages on the drum."

From the above brief summary of the information to hand it will be gathered that we have experienced a storm of quite considerable magnitude, not perhaps the worst that has ever been recorded, but at any rate a "great" disturbance.

Two important questions now arise. What is the cause of these sudden magnetic phenomena? Can they be predicted?

The first of these questions is one which is answered differently by different investigators. Some think that there exists a common cause external to the sun, while others are agreed that the storms originate from the sun itself; there are also many who go more into detail and are inclined to favour the view that they are caused by sunspots.

In the last mentioned case then it is natural to conclude that when there is a large spot we should experience a magnetic storm, and when there are no spots storms should be absent. This, however, is not the case. The true explanation must account for the three possibilities of the appearance of these storms.

(1) A large spot *with accompanying* magnetic disturbance and auroræ.

(2) A larger spot *with no accompanying* magnetic disturbance and auroræ.

(3) No great apparent solar activity, but magnetic disturbance and auroræ.

Since sunspots cannot be held to satisfy these necessary conditions, are there other solar disturbances which can be utilised? Yes, there are the prominences which were first seen projecting beyond the dark limb of the moon during total solar eclipses. Up to the year 1868 these were the only opportunities when such solar appendages could be observed, but during that year a method was discovered by Sir Norman Lockyer and Dr. Janssen by which they could be seen on the sun's limb at any time without the necessity of waiting for these brief opportunities. It was not, however, until the year 1870 that regular observations of the limb of the sun showing these indications of solar activity were

commenced, but, thanks to the magnificent work of Respighi, Tacchini, Ricco, and Mascari, we have practically a continuous record of them up to the present time.

The question then arises, are these prominences in any way related to the occurrence of magnetic storms? Before answering this, a few preliminary remarks may be made.

In the first place the number of spots on the sun is nearly always insignificant compared to the number of prominences. Prominences are, therefore, of greater relative importance than spots.

While sunspots are restricted to practically a narrow zone ($\pm 5^\circ$ to $\pm 35^\circ$) on each side of the solar equator, prominences can and do occur all over the sun's disc. Again, the general trend of the spot circulation is from the higher to the lower latitude, while in the case of prominence the reverse happens. In some years we have a great number of prominences near the solar equator, while in other years they are observed also in great numbers near the solar poles. A glance at some curves recently published in this Journal (vol. lxviii. p. 257, July 16) will shown not only the general drift

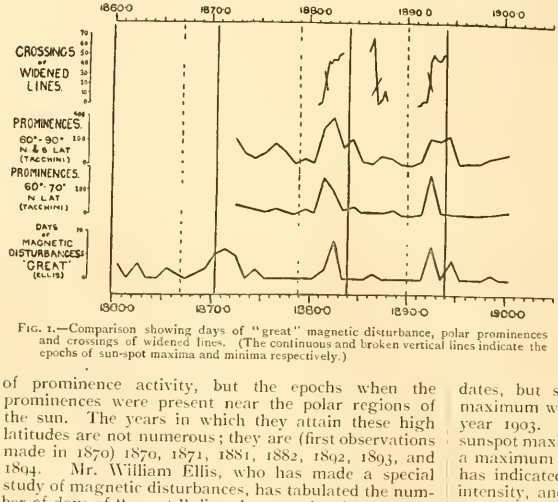

FIG. 1.—Comparison showing days of "great" magnetic disturbance, polar prominences and crossings of widened lines. (The continuous and broken vertical lines indicate the epochs of sun-spot maxima and minima respectively.)

of prominence activity, but the epochs when the prominences were present near the polar regions of the sun. The years in which they attain these high latitudes are not numerous; they are (first observations made in 1870) 1870, 1871, 1881, 1882, 1892, 1893, and 1894. Mr. William Ellis, who has made a special study of magnetic disturbances, has tabulated the number of days of "great" disturbances, that is, those recorded at Greenwich above a certain standard. These are utilised to form the following table:—

Date	Number of years	Number of days of "great" magnetic disturbances	Average per year
1870–1872	3	16	5·33
1873–1880	8	2	0·25
1881–1882	3	10	3·33
1883–1891	9	1	0·11
1892–1894	3	7	2·33
1895–1900	6	2	0·33

Another and perhaps more striking way of showing the coincidence of the epochs of the occurrence of days of magnetic disturbances and polar prominences is illustrated in the accompanying figure (*see* NATURE, February 19, vol. lxvii.).

The continuous and broken vertical lines indicate the epochs of maxima and minima sunspots, showing that the former tend to occur later than the peaks of the magnetic curves. In this diagram Respighi's observations of polar prominences made during the years 1870 and 1871 are not included, but their mean latitudes for each hemisphere during these years were $\pm 70^\circ$.

It will thus be seen from the above that the occurrence of polar prominences is closely associated, at any rate in time, with great magnetic storms, and, therefore, with auroræ, which nearly always accompany them. Further, prominences fulfil the three conditions mentioned previously in this article, for they can occur when there are spots and also when there are none.

One argument used against the prominence theory is that the polar prominences are "quiet" prominences and therefore are not likely or are possibly not capable of producing such large terrestrial effects. The critic may, however, have forgotten to consider the possible and natural conclusion that the appearance of prominences in high latitudes may at least be simply an indication of greater action occurring nearer the equatorial regions with consequent greater extension of the disturbed region towards the polar zones.

That the polar regions of the sun are sometimes greatly disturbed is again emphasised by the presence of enormous streamers that are seen in those regions during some total solar eclipses. Further, these polar streamers are observed only at those times when the prominences approach high latitudes. Here again we have good cause to doubt the inability of these polar prominences as disturbing agents. Even if the prominences be not conceded to be the initial cause of magnetic storms, their gradual changes of position towards the solar poles may afford a valuable means of forecasting the epochs of magnetic disturbances.

From the facts before us let us consider the question of forecasting the years in which magnetic storms should occur. If the reader will glance at the figure accompanying this article and continue the curves on the assumption that the last sunspot minimum occurred in 1901·5 and the next maximum in 1905, he will most probably make a maximum fall between these two dates, but somewhat nearer the latter; in fact the maximum would have been placed in the middle of the year 1903. It will be noticed, however, that at the sunspot maximum of 1870 the disturbance curve reaches a maximum a year after 1870. A recent investigation has indicated that all sunspot cycles are not alike in intensity, and that the cycle commencing in 1901 may probably correspond to that which commenced in 1867. If, therefore, the coming sunspot maximum should attain the same dimensions as that reached in 1870, it seems quite possible that the magnetic disturbance curve for the present cycle should correspond to that portion commencing about 1867. If this be so, then not only should polar prominences be recorded from the years 1903 to 1906 or 1907, but during these years "great" magnetic disturbance will be liable to occur. As shown in the previous table, no less than 16 of Ellis's "great" magnetic storms occurred between 1870 and 1872; also two occurred in 1869 and one in 1868, so that if we consider the present year to correspond to 1868 there is much in store for us. It may be mentioned also that since the years 1899 and 1900 the prominences have exhibited the tendency to attain high latitudes, so that there seems every reason to suppose that magnetic storms and auroræ may be experienced during the course of the next three or four years, after which there will be a cessation for about ten or eleven years. WILLIAM J. S. LOCKYER.

A NEW NATURAL HISTORY.[1]

IN our notice of the earlier portion we stated that it was then impossible to arrive at a definite conclusion as to the merits of this work, since the section in question was more or less introductory in its nature. Now that the author has got into the full swing of his subject, such a judgment is possible, and we have much pleasure in saying that our own verdict is in the main one of decided approbation. The author has had practically a new field before him, so far, at least, as English natural histories are concerned, in the mode of treatment of his subject, and the work ought to prove invaluable to all teachers of "nature-study." The illustrations—both coloured plates and text-figures—are in many cases excellent, some of them depicting the animals in attitudes or actions connected with the subject of the text. Examples of this type of illustration are afforded by the figure of a secretary-bird beating down a snake with its wings and beak, and that of a chamæleon darting its tongue at a fly.

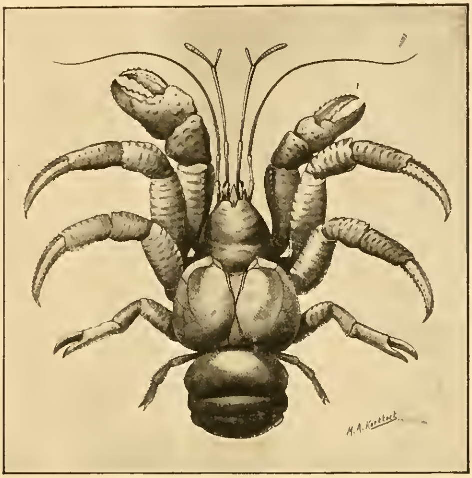

FIG. 1.—Cocoa-nut Crab (*Birgus latro*). From Davis's "Natural History of Animals."

In the first of the two half-volumes before us, the author commences by treating of the food of animals and the structural modifications of the animals themselves in correlation therewith, a subject which occupies the whole of one of the fasciculi and part of the other. This part of the subject is divided into three sections, according as to whether the diet is of an animal, vegetable, or mixed nature, each main group being taken in serial order in the several sections, commencing with mammals and finishing with zoophytes and sponges. Animal defences forms the title of the next main division of the subject. Here protective coloration and colour changes, mimicry, and the reason why so many animals are nocturnal, are discussed at length, and in the main satisfactorily, although all the latest observations on the former part of the subject are not mentioned. Passive defence, as exemplified by dermal armour, shells, the rolling-up habit, and the death-feigning instinct, and then active defence receive in turn their due share of attention, the second half-volume ending with an excellent dissertation on the various forms of animal respiration.

Unfortunately, the general excellence of the book is somewhat marred by certain blemishes. Confining our criticisms to a single group of animals, we have in the dental formula of the cat on p. 7 the number of pairs of incisors given as two instead of three. Nor can this error be attributed to the printer, for, although the total number of teeth in the animal is rightly given as thirty, the incisors are referred to in the text (as well as in the formula) as being eight, in place of twelve, in number. Moral, in proof-reading always add up your dental formula. Again, in the explanation of the figure of the dentition of the thylacine on p. 16, it would have avoided liability to error if the number of upper incisors had been alluded to as *four pairs* instead of *four*. Perhaps it is a venial error to perpetuate (p. 9) the old idea that the coloration of the tiger is designed solely to harmonise with an Indian grass-jungle, but it shows a decided want of acquaintance with modern zoological work to allude

FIG. 2.—Gila Monster, or Arizona Poisonous Lizard (*Heloderma suspectum*). From Davis's "Natural History of Animals."

[1] "The Natural History of Animals." Half vols. iii. and iv. By J. R. A. Davis. (London: Gresham Publishing Co., 1903.)

to the aard-wolf (p. 15) as a solely South African animal. More serious is the repetition of the error that blue foxes are the summer representatives of white foxes (p. 19), both being, as a matter of fact, in the winter coat. In our notice of the first two parts, we directed attention to a discrepancy between the lettering of some of the coloured plates and their descriptions; the same thing occurs in the plate of the polar bear facing p. 20, the animal being called *Ursus arctos* in the one place and *U. maritimus* in the other. Finally (p. 172), Euelephas is not the generic name for the Indian elephant, while there is no sort of justification for alluding to the polecat (p. 289) as *Putorius ermineus*, and the weasel (p. 290) as *Mustela vulgaris*, both animals belonging to the same genus, whether this be called by the one name or the other.

As samples of the better class of illustrations in this volume, we reproduce the figures of the cocoa-nut crab (Fig. 1) and of the "Gila monster," or Arizona poisonous lizard (Fig. 2). R. L.

NOTES.

THE American Academy of Arts and Sciences has, says *Science*, elected Dr. Joseph Larmor, F.R.S., as foreign honorary member in succession to the late Sir G. G. Stokes.

THE eighty-fifth session of the Institution of Civil Engineers was opened on Tuesday, when Sir William White, the new president, delivered an inaugural address of great importance, in which he discussed the main lines of recent advance in ship construction, the present conditions of British shipping and ship-construction, and warship building since 1860.

IT is announced by the *Electrician* that this year it is proposed to award the Nobel physics prize to Signor Marconi, the chemistry prize to Prof. Arrhenius, and the medicine prize to Prof. Finsen. Each prize is worth about 8000*l*.

THE United States National Academy of Sciences will hold its autumn meeting in Chicago, beginning on November 17.

WE regret to learn of the death on September 24 of Mr. J. A. Brown, aged seventy-two. He was an enthusiastic collector of flint implements, and author of a work entitled "Palæolithic Man in N.W. Middlesex" (1887).

A REUTER telegram from Stockholm states that Baron E. Nordenskjold has arranged to make a zoological and anthropological expedition to the frontiers of Peru and Bolivia. The expedition will start at the end of December or the beginning of January.

REFERRING to the suggested existence of radium in the sun, a correspondent points out that not a single line in the ultra-violet spectrum of radium described by Sir William Crookes (*Proceedings* Roy. Soc., vol. lxxii., No. 482) coincides exactly with a solar line. "The strongest radium line in Sir William's list is 3814·661, which is very near the solar line 3814·671 assigned to iron and carbon, but is not coincident with it."

THE *Terra Nova* and the *Morning*, the vessels which are to go to the relief of the Antarctic expedition on board the *Discovery*, have arrived at Hobart. The two vessels will leave together in the first week of December. The Swedish ship *Frithiof*, which is going to the relief of Dr. Nordenskjold's Antarctic Expedition, arrived at Buenos Ayres on October 30.

AT the end of last session it was decided to hold the meetings of the Physical Society alternately in the afternoons and evenings, and to change the place of meeting from the Chemical Society to the Royal College of Science, where the facilities for experimental demonstration are very complete. The first evening meeting will be held on Friday, November 13, at 8 p.m., when Sir Oliver Lodge will describe and illustrate by experiments (1) means for electrifying the atmosphere on a large scale, and (2) an arrangement for driving mercury pumps.

THE Paris correspondent of the *Times* states that the Sanitary Conference has at present under its consideration a project for the creation of an international sanitary bureau for the collection of information respecting infectious diseases, such as plague, cholera, and yellow fever, and also for the harmonious working of those sanitary regulations in the East which have so greatly contributed within the last five years to the preservation of public health as well as to the benefit of trade by the suppression of the old quarantine system. The international sanitary bureau would have its headquarters in Paris.

CAPTAIN J. M. JAMES, of Tokio, sends the following table showing the dates on which the first fall of snow took place on the summit of Fuji-Yama, the height of which in 1884 was 12,425 feet ±25 feet:—1884, October 6, light; 1885, September 27, light; 1886, October 7, light; 1887, October 2, heavy fall; 1888, October 1, heavy fall; 1889, September 25, heavy fall; 1890, October 4, light; 1891, October 12, heavy fall; 1892, September 25, light; 1893, October 7, heavy fall; 1894, September 22, light; 1895, October 3, light; 1896, September 21, light; 1897, October 5, light; 1898, September 26, heavy fall; 1899, September 16, heavy fall; 1900, September 25, heavy fall; 1901, September 25, heavy fall; 1902, September 19, heavy fall; 1903, September 27, heavy fall.

AT the recent meeting of the German Association at Cassel, Prof. Penck, of Vienna, was to have given an address on geological time, but illness prevented him from doing so, and his place was taken at the last moment by Prof. Conwentz, of Berlin. The writer of the article upon the meeting, in NATURE of October 15 (p. 586), was unaware that any change had been made, and the titles he gave of addresses for delivery on September 22 were those announced in the programme. Prof. Conwentz has now sent us a report of his address, which dealt with the preservation of remarkable natural objects, especially of rare living plants and animals. He pointed to the destruction of orchids in Thüringen, the extermination of rare thistles on the German coasts, the cleansing of brooks from aquatic vegetation, and the destruction of large trees, and argued that, both for scientific and æsthetic reasons, districts should be set aside where the natural features of the country should be preserved, while care should be taken not to destroy needlessly objects of interest to natural history.

IN a letter to NATURE of August 6, Messrs. Hutchins, of Cape Town, referred to the "Research on the Eucalypts Especially in Regard to their Essential Oils" by Messrs. R. T. Baker and H. G. Smith, reviewed in NATURE for April 2 (vol. lxvii. p. 524). The authors of this memoir have sent us a long letter of reply, in the course of which they say that the remarks upon their work are likely to lead to the idea that it has been confined to the chemistry of Eucalyptus oils almost entirely, and that new species have been named and a new classification for the Eucalypts formulated without sufficient warrant. They proceed to point out that their results are not those of the chemist

alone, but the joint efforts of a botanist and a chemist, and are supported by the field knowledge of botany of the botanical collector to the Sydney Technological Museum, and by numerous Australian authorities on the Eucalypts.

THE lecture on the "New Star in Gemini," delivered by Prof. H. H. Turner at the Royal Institution on June 5, has just been issued as an excerpt from the *Proceedings* of the Institution. Prof. Turner does not confine himself to his discovery of Nova Geminorum, but deals with the nature of new stars generally. He regards dark patches on the celestial sphere as not being actual voids in the stellar universe, but dark nebulæ which hide the light from stars beyond. A new star is due to the collision of a star with such a mass of invisible matter as this; for, adds Prof. Turner, "The friction of the encounter raises the temperature of the star enormously within a day or two, just as a meteor, on entering our tenuous upper atmosphere, is set ablaze in a second or two." This idea is, of course, fundamentally the same as that put forward several years ago in the meteoritic hypothesis as to the origin of new stars; and it is interesting to notice how the stone which the builders of astronomical theory rejected at that time has become the head of the corner since the phenomena of Nova Persei demonstrated the existence of masses of non-luminous matter in celestial spaces. But why did not Prof. Turner remember that Nova Persei only confirmed an explanation of the causes of the phenomena of new stars put forward long ago? He expresses anxiety lest England should fall behind in the progress of scientific discovery "for want of men and money, but especially men," and while we share his uneasiness of mind, his address gives rise to a wonder whether he knows what men have done, and are doing, for the advance of astronomy in this country.

THE Prussian Meteorological Institute (Berlin) has recently issued its report for the year 1902. This organisation deals especially with climatology, rainfall, and unusual atmospheric occurrences, while the Deutsche Seewarte (Hamburg) is chiefly occupied with marine meteorology and weather telegraphy. With the Berlin Institute is associated the meteorological and magnetical observatory at Potsdam, and the aëronautical observatory at Tegel. The latter establishment is carrying on a very valuable work in the investigation of the meteorological conditions of the upper air by means of kites and registering balloons, and has, since August, 1902, made daily ascents, the results of which are communicated by telephone to the Berlin office. On one occasion, in December last, a kite attained the unusual height of 5500 metres. These ascents are, in addition to the experiments with manned and unmanned balloons, undertaken in connection with the international monthly balloon ascents, to which we have had frequent occasion to refer. The magnitude of the useful work performed may be gauged from the fact that, including the observations from ordinary meteorological stations, rainfall statistics are received from 2574 places, and that no less than 37,273 reports were received from 1412 stations dealing especially with thunderstorms and unusual occurrences. The latter observations are published yearly in addition to the regular publications of the Institute, together with charts showing the place of origin, the tracks, and the velocity of the storms.

IN the *Annalen der Physik*, 10, Messrs. L. Holborn and F. Kurlbaum describe an optical pyrometer, first constructed in 1901, in which the temperature of an incandescent body is determined by photometric observations of the emitted radiations.

THE permanence of resistance standards of sheet manganese is discussed in the *Zeitschrift für Instrumentenkunde* by Mr. St. Lindeck, of Charlottenburg. Thirty-one resistances were experimented with from October, 1901, onwards; twenty-six of these were found to vary by not more than 0·05 per cent., and of the ten in which the variations exceeded 0·02 per cent., seven were large models which were subjected to currents of considerable intensity.

A NEW method of producing tension in liquids is described by Mr. J. T. Jackson in the *Scientific Proceedings* of the Royal Dublin Society (x., part i., 8). The method consists in the application to the particular question considered of the well-known principles governing the flow of liquid in a pipe of variable section. At a constriction the velocity increases and the pressure diminishes, and the author finds that under certain conditions the pressure can be made negative, thus confirming the well-known result according to which liquids may sustain a considerable tension without rupture.

DURING the past year several fragments of richly carved crosses have been found built into Lancaster Parish Church, which range from the earliest type of fine old Anglian work to late sculpture of the Danish period in the tenth and eleventh centuries. These most interesting relics have been described and figured by Mr. W. G. Collingwood in the current number of the *Reliquary and Illustrated Archaeologist*.

IN January, 1901, Mr. F. J. Horniman, M.P., gave his new museum and library, and the adjoining estate and the houses thereon, to the London County Council as places of public recreation and instruction; practically the only condition was that they were to be maintained in a proper state and dedicated to the public for ever. The London County Council has just issued its first annual report, which comprises a period of eighteen months. The report, which is illustrated, briefly states the history of the museum and of its transference, and gives a synopsis of the contents of the museum and of the scope of the library. The former arrangement of the museum has for the present been adhered to, and numerous descriptive labels have been prepared with the view of increasing the educational value of the museum. In the autumn term Dr. A. C. Haddon, F.R.S., the advisory curator, gave a course of lectures to teachers on the natural history of animals, which was illustrated by specimens in the museum and by lantern slides; owing to the large attendance it was necessary to give the lectures in a gallery; the average attendance at the lectures was 114. The total attendance at the museum for 1902 was 238,589, being an average of 658 on the opening days. The museum was visited by ninety-seven schools and institutions, with an average attendance of nineteen children. From these figures it will be seen that the educational advantages of the museum are appreciated, and there is every reason to believe that the next annual report will show that these are being increased. It may be added that the Horniman Museum and Library (at Forest Hill, S.E.) are open free to the public from 2 p.m. to 9 p.m. every day in the year except Christmas Day.

FROM the report of the Natural History Society of Northumberland, &c., we are glad to learn that the threatened split between that body and the Tyneside Naturalists' Field Club, to which allusion was recently made in our columns, has been avoided, and that for the future the two institutions are to amalgamate their forces.

IT is distinctly refreshing to find an American naturalist protesting against slavish adherence to the "fetish of

priority," as it is called by Dr. Gadow, in nomenclature, especially when there may be a doubt as to whether the names are really synonymous. In No. 76 (vol. xi.) of the zoological series of *Publications* of the Field Columbian Museum, Dr. D. G. Elliot directs attention to the use of the term Odocoileus for the American white-tailed deer and its relatives. That term was proposed by Rafinesque in 1832 for a fossil premolar of some kind of deer, which has been assumed to belong to the whitetail or some closely allied species. Even if this be really the case, Dr. Elliot doubts "whether a genus founded upon some fossil remains of an otherwise entirely unknown animal of a past age should be unhesitatingly adopted for a group of existing species that may be, in the majority of its characters, widely different from the extinct form." He further suggests the inadvisability of adopting palæontological names in any case for living forms, but adds that if such are used, the name Anoglochis, applied to European Tertiary deer, seems, as pointed out by Mr. Lydekker, to be available for the whitetail. It may be pointed out that, instead of giving a new name to the fossil deer-tooth, Rafinesque ought to have called it Cervus, and that by adopting Odocoileus we perpetuate an instance of ignorance and incapacity on the part of its proposer.

REFERENCE may be made to another change of nomenclature which, if adopted, is likely to cause the extreme of inconvenience with no resulting advantage. Almost from time immemorial the marmosets have been known as Hapale and the titi monkeys as Callithrix. In the October issue of the *Annals*, a well-known zoologist proposes to transfer the latter term to the marmosets (for which it appears to have been first employed) and to give a new name to the marmosets. In such instances, we venture to think, a "statute of limitations" should be insisted on. The replacement of well-established names is bad enough, but their transposition is unspeakable.

Two parts of vol. x. of the *Decennial Publications* of the University of Chicago are to hand. In the one Mr. A. C. Eycleshymer treats of the early stages of the development of the bony pike (*Lepidosteus osseus*), as observed in living specimens and preserved material. After treating this exhaustively, the author compares the phases with those of the few other living representatives of the enamel-scaled fishes, concluding with general remarks on the character and significance of yolk-cleavage. The view that similarity in the first four stages of cleavage indicates kinship between the bony pike and teleost fishes is not accepted. The second of the two is devoted to the results of a study of the development of colour and colour-pattern in beetles and in insects generally, by Mr. W. L. Tower. It appears that insects show two distinct types of coloration, the one —dermal (or cuticula) and hypodermal—as ancient as the group itself, and consisting of colours arranged in segmentally disposed spots and stripes, correlated with the deeper vital organs; the other, of much later origin, produced by scales, or modified hairs. This secondary type tends to suppress and obscure the original one, and, being developed independently of the vital structures, permits of much greater variation and diversity; it is, in fact, a purely ornamental type. The essential difference between the two may be realised by contrasting the sombre browns and yellows of the ground-beetles of the genus Carabus with the brilliant pattern of butterflies of the Vanessa group. Cuticula colouring (as shown in the beautifully coloured plate of beetles) commences in the fore part of the body, where the muscles first harden, and gradually spreads backwards. It is clearly connected with the hardening of the cuticula, which tends to become brown, hence the prevalence of browns and yellows in so many beetles and cockroaches, metallic tints in the former being due, of course, to another cause.

DR. WACE CARLIER and Mr. Lovatt Evans have made some interesting observations upon the so-called hibernating gland of the hedgehog (*Journ. Anat. and Physiol.*, xviii., part i.). This is of an orange colour when fully developed, but becomes deeper in tint as the winter sleep progresses, until, towards its end, it is almost black. It at first averages 1–2 per cent. of the body weight, rises by the second month to 2·7 per cent., and then gradually falls 1 per cent. towards the close of hibernation. Careful analyses show that, to commence with, the gland contains 40 per cent. of fat, and that this is reduced to 18 per cent. at the end of hibernation, the proteids during the same period showing a reduction of only 1 per cent. At the beginning of hibernation (October) the animals are exceedingly fat, but by the end of March all the fat stored in the tissues has disappeared. For the first month the weight of the hibernating gland falls rapidly, much fat being removed, but from then until the end of March there is little change, when again the gland loses weight owing to removal of its contained fat, and by the end of May it is completely exhausted and reduced to a mere fibrous cord. It would seem that life during hibernation is maintained practically upon fat alone, and that the hibernating gland is a store of fat reserved for this purpose.

WE have received No. 9, vol. i., of the *Scientific Roll* conducted by Mr. Alexander Ramsay. It deals with the bacteria, which are arranged according to their size, no other information being given than the name of the organism and its "size" position. We have already expressed the opinion that this list is an example of misplaced energy, because there is no such thing as a fixed size for a bacterium, the size varying considerably with alterations in the nutrient soil and other conditions.

THE problem of tracing out the connection of flowering plants with lower types must always possess attraction for botanists. In a number of the *Decennial Publications* of Chicago, Prof. Coulter has expressed the general views held by botanists that a similar line of development is probably not to be expected for monocotyledons and dicotyledons, and that neither of these groups are directly connected with the gymnosperms. The positive suggestion is made that the origin of flowering plants is to be traced to that group of ferns which is represented at the present day by Marattia and Angiopteris.

A GRAPHIC account of some of the curiosities of flora and fauna of the Auckland Isles and Campbell Island is given by Mr. L. Cockayne in the *Lyttelton Times*, wherein he relates the general impressions obtained during a short cruise in southern waters. Contrasts between the flora of these islands and that of New Zealand were observed in the brighter, generally purple or bluish tinge of colour, as compared with white or yellow tones which predominate in similar flowers found in New Zealand; this brightness is not associated with insect visitors, for they are wanting. Again, in New Zealand herbaceous plants rarely die down in winter, whereas in the southern islands many do so, but not owing to the cold, for the forests keep their summer aspect. On Adam's Island Mr. Cockayne had an opportunity of studying the nests of the albatross placed in exposed situations, where the solitary chicken remains on the nest for a year, and on the desolate Bounty Islands were found the nests of the mollyhawk, and numbers of animals, crustaceans, spiders and beetles which make their home in the guano or on the bare rocks.

DR. C. H. LEES wishes to make the following corrections in his account of the British Association discussion on the nature of the emanations from radio-active substances which appeared in NATURE of October 22. In the last line but two of the third paragraph on p. 611, "not yet found to be non-radio-active" should read "not yet found to be radio-active," and in the fifth line from the bottom of the column, "high velocities of the emanations" should read "high velocities of the radiations."

A SECOND edition, revised to June 30, 1903, of the "Student's Handbook of the University and Colleges of Cambridge" has been published by the Cambridge University Press. In addition to a few minor alterations the following important additions have been made to the book, viz. a complete list of university professors, readers, and lecturers, a list of lectures on honours subjects given in the university, and a statement of the set subjects for special examinations. The new regulations for the mathematical papers in the previous examination are also given.

THE first volume of administrative reports and the official reports of the meetings of the International Council for the Study of the Sea deals with the work of the year ending July, 1903, and has now been published by MM. A. F. Høst et Fils, of Copenhagen. The character of the work of this international council was described in our issue for September 3. The volume now published contains the main results of the work arranged by the council for the year dealt with, printed in both English and German.

THE second part of the "Botany of the Færöes," which is based upon Danish investigations, has now been published in Copenhagen by Det nordiske Forlag (London: John Wheldon and Co.). It was expected that this part, together with that published in 1901, would complete the work, but it has been found that a third volume will be necessary. Part iii. will contain papers on the vegetation of land and sea, and will, Prof. Eug. Warming says in a prefatory note, most likely be ready in a year or two.

AT the beginning of next year the firm of Gebrüder Borntraeger, Berlin, will commence the publication of a comprehensive review of progress in physical chemistry under the title "*The Physico-Chemical Review*: a complete international review of the sciences of physical chemistry and the allied branches of chemistry and physics." The magazine will be edited by Dr. Max Rudolphi, Darmstadt, with the cooperation of distinguished chemists and physicists in many parts of the world. The new journal is not intended to be a medium for the publication of original work, but a review of such work described in abstracts furnished, so far as possible, by the authors of papers. It is proposed to include English and French as well as German abstracts. The whole domain of general and physical chemistry, as well as the allied sciences on both sides, so far as they bear on physical chemistry, will come under review. Such an international review will prove of importance and value to practical men as well as to those engaged in the pursuit of purely scientific research. The review will be issued twice a month. Specimen numbers will be sent post free upon application to the publishers, Gebrüder Borntraeger, Berlin SW 11, Dessauer Strasse 29.

THE volume of *Transactions and Proceedings* of the New Zealand Institute for 1902 has been received. This is the thirty-fifth volume published by the board of governors of the Institute, and it is edited by the director, Sir James Hector, F.R.S. Copies can be obtained in this country from Messrs. Kegan Paul, Trench, Trübner and Co. It is impossible to refer to the contents of the sixty papers forming the *Transactions* part of this bulky volume. These original articles are divided into five sections, viz. papers dealing with zoology, botany, geology, chemistry and physics, and miscellaneous subjects. The thirty-fourth annual report of the New Zealand Institute precedes the next main division of the volume, which includes the proceedings of the various incorporated societies, viz. the Wellington Philosophical Society, the Auckland Institute, the Philosophical Institute of Canterbury, the Otago Institute, the Hawke's Bay Philosophical Institute, the Southland Institute, and the Nelson Institute. An appendix contains a tabulated report of the earthquakes in New Zealand during 1902, and seismograph records from different observatories throughout the country for the same year. The volume concludes with fifty-four well executed plates illustrating various papers included in earlier pages.

THE vacation number of the *Berichte* contains two papers on fluorescence. In the first of these Richard Meyer criticises Dr. Hewitt's theory that fluorescence is dependent on oscillatory isomeric change, and urges that a "fluorophore" group must also be present in the molecule. The paper by H. von Tappeiner on the action of fluorescing substances on ferments and toxins is a continuation of a research in which it was shown that fluorescent substances, which have little action on micro-organisms in the dark, become very poisonous in sunlight; thus a culture of Paramecium exposed to sunlight was destroyed in six to ten minutes by a trace of acridine hydrochloride which produced no effect in 100 hours in the dark; of the fluorescent substances examined only æsculin was without action both in the dark and in sunlight. The hydrolysis of starch by diastase is not affected by exposure to sunlight or by the addition of eosin, but if the solution to which the eosin has been added be exposed to sunlight, the yield of maltose is reduced from 76 to 21 per cent.; this retardation, which is only produced by a limited number of fluorescent substances, can be detected when the proportion of eosin is only one part in 400,000, but disappears entirely if the incident light is filtered through a layer of the fluorescent substance. The action of invertin on cane-sugar is also checked by the addition of eosin when the solution is exposed to sunlight, and the effect of one part of eosin in a million can be easily detected. Papayotin appears to be even more sensitive than diastase or invertin. The only toxin investigated was ricin; unlike the enzymes, this was destroyed by all the fluorescent substances examined with the exception of æsculin, but was not injured by non-fluorescent dye-stuffs or by fluorescent substances if kept in the dark.

A PAPER by Knoevenagel on the nature of the double-bond appears in the vacation number of the *Berichte*. In order to account for the conversion of butadiene, $CH_2:CH.CH:CH_2$, into dibromobutylene,

$$CH_2Br.CH:CH.CH_2Br,$$

he suggests that in compounds of this kind the carbon atoms are in a state of oscillatory motion, so that the molecule has, alternately with the formula given above, the structure represented by the formula

$$—CH_2.CH:CH.CH_2—.$$

Applying this theory to the benzene molecule, it is no longer necessary to assume a pendulum-like motion, as the carbon atoms may be regarded as revolving continuously, alternate atoms rotating to the left and to the right; the result of

this motion is that the three double bonds travel round the ring, whilst a labile form of the molecule with six free valencies is also indicated. In this way many of the peculiar properties of aromatic compounds may be accounted for.

THE additions to the Zoological Society's Gardens during the past week include a Sooty Mangabey (*Cercocebus fuliginosus*) from West Africa, presented by Mr. C. J. Spencer; a Levaillant's Cynictis (*Cynictis penicillata*) from South Africa, presented by Miss Bald; a Blue and Yellow Macaw (*Ara chloroptera*), a Red and Yellow Macaw (*Ara ararauna*) from South America, presented by General Sir Frederick Forestier Walker, K.C.B., G.C.M.G.; two Wharton's Fruit Pigeons (*Carpophaga whartoni*), a Christmas Island Dove (*Chalcophaps natalis*), five Christmas Island Crabs (*Birgus latro*) from Christmas Island, presented by Captain A. W. Cole; a Chameleon (*Chamaeleon vulgaris*) from North Africa, presented by Mrs. T. Wallis; seven Spiny-tailed Mastigures (*Uromastix acanthinurus*) from North Africa, three Brazilian Amphisbaenas (*Amphisbaena brasiliana*) from Brazil, an Indian Eryx (*Eryx johni*) from India, two Sharp-nosed Snakes (*Lioheterodon madagascariensis*) from Madagascar, deposited; six Black Swans (*Cygnus atratus*) bred in the Gardens.

OUR ASTRONOMICAL COLUMN.

THE FORMATION OF THE POLAR CAPS ON MARS.—An interesting paper, by Mr. Percival Lowell, which deals with the manner of formation of the Martian polar caps is published in No. 2 of the Lowell Observatory *Bulletins*. Mr. Lowell observed the old polar cap on July 3, and found it to be diminishing; on July 5 it was only 20″ of arc in diameter, equal to a diameter of 48°.1 on the planet's surface; and shortly afterwards he noticed that a new, large, white deposit had formed, north of Arethusa Lacus and touching the Pierius-Callirrhoe, in longitude 345°. This new white patch extended from the old polar cap to about latitude 55° N., and the Pierius, which it crossed, could be seen running through it, thereby showing that the appearance was due to a deposit and not to clouds, which would have obliterated all the features equally; it also indicates that some kind of vegetation which had caused the deposit partially to melt, exists in the neighbourhood of the Pierius.

From July 7 to 17 the dark line of demarcation which usually surrounds the cap became less marked, until it was finally obliterated by the encroaching deposit of frost, only a superior whiteness, caused by the newly deposited frost lacking the sheen of the older, weathered and ice-welded snow, marking the presence of the older cap. It is only reasonable to suppose that this deposit actually was frost as we know it, for it is evident that a layer of frozen gas, such as solid carbon dioxide, would pass directly from the solid to the gaseous form under the pressure conditions obtaining on Mars, and would not exhibit the phenomenon of slowly melting such as was observed in the region about the Pierius.

The quick melting of the outer and the durability of the inner portion of the Martian snow-cap are both explained by these observations, which show that the whole cap consists of a perpetual kernel which periodically becomes surrounded by a shallow transitory husk, the formation of which was observed by Mr. Lowell.

The same observer also performed some experiments in connection with the visibility of the Martian canals, which showed that a wire having an angular width of 0″.60 at 1800 yards could be readily "glimpsed" with the naked eye, and from this he deduces that any canal having a width of half a mile on the planet's surface should be readily observable with a good telescope.

WOLF'S VARIABLE STAR 50, 1903, CYGNI.—A communication from Prof. Pickering to the *Astronomische Nachrichten* (No. 3911) states that the star recently announced by Wolf as being a probable nova appears on a large number of plates taken at Harvard between October 29, 1891, and the present time. On a plate exposed on July 30, 1895, the spectrum of this star is of the fourth type, and, from the series of plates, it is seen that the brightness varies by more than two magnitudes.

In the same periodical Prof. Wirtz records an observation made by him at Strassburg on October 15, when he found that the approximate magnitude of this object was 10.5, and that a comparison of its focus with that of several known stars on the Strassburg refractor showed no difference. The identity of this variable with the star B.D. +37°.3876 is confirmed by Prof. Wirtz.

PERIODICAL CHANGES IN THE COLOURS OF JUPITER'S BELTS.—In No. 3908 of the *Astronomische Nachrichten*, Mr. Stanley Williams directs attention to the periodical colour changes of Jupiter's equatorial belts announced in vol. lix. (p. 375) of the *Monthly Notices*.

The computed times of the maximum and minimum brightness of the respective belts are very uncertain, and Mr. Williams suggests that careful observations should be immediately commenced with the object of exactly determining the date when the red colour has entirely disappeared from the southern belt, and also the date of its corresponding reappearance, which will probably take place some time next year.

Mr. Williams's own observations indicate that the red colour has already almost entirely disappeared from this belt, some parts actually appearing blue, except in the neighbourhood immediately following the Great Red Spot, between longitudes 60 and 180, whilst the northern belt is of a bright, deep red colour.

THE MULTIPLE TAIL OF COMET 1903 *c*.—In discussing a number of beautiful photographs of Borelly's comet, which were obtained at Yerkes with a lantern lens having an aperture of 1·6 inches and a focal length of 6·3 inches, and are reproduced in the current number of the *Astrophysical Journal*, Prof. Barnard advances a novel explanation of the great changes of form which were observed in the tails of this and other comets.

From two photographs taken at Yerkes on July 24, the one immediately after the other, and one taken by M. Quenisset at Nanterre on the same date, it is seen that an enormous change in the form of the tail took place at about 2h. 30m. (G.M.T.), when a section of it broke away from the head and travelled in a retrograde direction at a rate, referred to the motion of the head, of about 29 miles per second. As the velocity of the comet itself was, at this period, about 22 miles per second *towards* the sun, it will be seen that the actual velocity of the section showed a repulsion of 7 miles per second *from* that body.

As an explanation of this phenomenon, Prof. Barnard suggests that either the outburst from the coma suddenly took place in a slightly different direction, or else the existing tail was forcibly detached by some unknown body (*e.g.* a swarm of meteorites) and simply floated away in its old path, under the sun's repulsion, until it was dissipated, or its light-emitting power died away; meanwhile, the new tail was formed by the material evolved by the coma, and for some reason the particles were evolved with a greater velocity than before, so that we get the phenomenon of the two tails nearly parallel for some distance, as shown on the Yerkes and other photographs.

THE SWISS ASSOCIATION OF NATURAL SCIENCES.

THE eighty-sixth meeting of the Société helvétique des Sciences naturelles was held at Locarno on September 2–5. Both as regards the number of visitors and the number and variety of the papers read, the gathering was highly successful. Several of the communications presented at the general meetings of the Association were especially well received.

M. A. Pioda (Locarno), the president for the year, after referring to the naturalists of the nineteenth century in his presidential address, went on to show that, in the same way as all other sciences have gradually been differentiated from

metaphysics, it was now the case with psychology. He spoke of the importance of this process as far as the increase of knowledge is concerned, and also as regards the improvement of each of the sciences and their relations one to another. He then traced the experimental and speculative character of psychology. Experimental psychology, the president urged, should confine itself solely to the scientific observation of facts. Certain facts, called psychical (Wallace, Crookes, Zöllner, Thury, &c.), are incapable of any explanation, at least by known physical forces, and it is the duty of science to examine these if psychology is really to assume an experimental character. The facts referred to belong, it may be, to psychophysics. When psychology has really become an experimental science such phenomena will be known not only by their external manifestations, but also by their hidden source, and the knowledge of them will become an organic whole.

Mr. E. Fischer (Bern) read a paper on the biological species of parasitic fungi and of the origin of new forms in the vegetable kingdom. The nature and properties of biological species were studied particularly in the Uredinées, and more recently in *Claviceps purpurea*. Philogenetically, at present, a common origin is attributed to the biological forms of a *species*; consequently, it seems plausible that the original form (Stammform) inhabits all the hosts on which its descendants now live, and that some at least among its descendants may be specialised on one or other of the nourishing plants. Reciprocally, the passage of one parasite to new hosts has been observed directly. Among the causes of the origin of biological species, following Klebalen, is admitted in the first line the direct adaptation (Anpassung und Angewöhnung) of these nourishing plants. It was also said that the explanation given is not applicable at present to the origin of species morphologically different; the morphological characters of species are, at most, partially attributable to the direct action of the nourishing plants (Näherpflanzen), and for the most part they must be related to the characters of the organisation in the sense used by Nägeli.

M. H. Dufour (Lausanne) took for the subject of his paper to the conference ten years' observations of solar radiation in Switzerland, and its diminution in 1903. The Swiss plateau on the north of the Alps (Lausanne, Bern, Zürich, Bâle) has a number of hours of sunshine varying between 1900 at Lausanne and 1200 at Bâle, that is to say, 47–44 per cent. of the greatest insolation possible. The maximum occurs in August (64–57 per cent.), the minimum in December or January (27–29 per cent.); in March and May the insolation is relatively feeble. To the south of the Alps (Lugano, Locarno) 2300 hours of sunshine were recorded, 59 per cent. of the possible maximum; two minima occur in May and November, and two maxima in July and February, with 60 per cent. At Alpine observatories the character of the results changes. At Davos (1500 m.) the insolation is not so strong in winter as in summer, when 1800 hours of sunshine are recorded; two minima are observed—in January and May—and two maxima (February and September–October). At the summit of Säntis (2500 m.) the insolation of winter, 45 per cent., exceeds markedly that of summer, 40 per cent. The mean amount is 42 per cent; the minimum occurs in May and June, and the maximum in November. For the intensity of the solar radiation, measured by Bührer (Clarens-Montreux) and Dufour (Lausanne), the result has been obtained of 8·5 calories (kilogram-degrees) per minute and per square metre of normal black surface on the sun between 11 and 1 o'clock. The maximum occurs in April–May, the minimum in January. At an altitude of 400–500 m. it rarely exceeds 10 calories, at 2000 m. (Rochers de Naye) 13 calories. In 1903 the values of the actinometric measures are notably feebler than in previous years, probably because of an abnormal opacity of the atmosphere, which may be attributed to the diffusion in the air of dust arising from the violent volcanic eruptions of the Lesser Antilles, which would facilitate the condensation of aqueous vapour in the form of fog—very attenuated and invisible, but yet absorbent.

M. P. Weiss (Zürich) exhibited by means of a series of interesting experiments the new magnetic properties of pyrrhotine, that is to say, the directions in which crystals of this mineral are sensitive to the influence of magnets.

M. A. Lang (Zürich), in speaking of the biological significance of elegance in certain marine organisms, said that the scientific study of animal forms did not prevent an understanding of the æsthetic manifestations of nature which could be applied in decorative art, for instance. He showed that all those characters which give beauty and charm to the marine fauna—such as form and symmetry, phosphorescence, and transparency—enable these animal forms to respond to their environment, and thus to facilitate and assure their continued existence.

The number and importance of the communications which dealt with the canton of Ticino were very remarkable. M. C. Keller (Zürich), with his descent of the animal world of the Ticino cantons showed that the fauna principally studied by Stabile and Pavesi contains very different elements; the lacustrine is a *fauna relicta* (Pavesi), and the terrestrial contains arctico-alpine elements. But the most remarkable characteristics are those of the sylvatic fauna of central Europe, and also the great number of types of the Mediterranean subregion. He also made several interesting comparisons with the fauna of other Swiss regions, and showed several new researches for Ticino which have been found by him. At the same meeting M. F. Merz (Bellinzona) spoke on the forestry of the Ticino canton, and similar questions were referred to in various sections by MM. Freuler, Bettelini, Calloni, and Pometta.

The most largely attended sectional meetings were those concerned with physics and chemistry, and the most important papers read at these meetings were those of MM. Haller (Paris), Schär (Strassburg), de la Rive (Geneva), Nölting (Mülhouse), Forel (Morges), Bertoni (Livorno), Tomasina, Soret (Geneva), Schühmacher-Kopp (Lucerne), Riggenbach (Bâle), Hagenbach (Bonn), and others.

In the botanical section the most interesting communications were those of MM. Rikli (Zürich), C. Schröter (Zürich), A. Usteri, and Wilezeck (Lausanne); in the zoological section a magnificent monograph was presented by the honorary member, M. P. Pavesi (Pavia), on the fauna of the valley of Aosta, and papers were read by MM. Lang, Keller, Studer (Bern), Volz (Bern), and Pictet (Geneva); the section of geology and mineralogy mustered but a very small attendance, for the Swiss geologists were almost all at the international congress at Vienna.[1]

The excursions and the receptions, which took place in exceptionally fine weather, the cordial welcome and generous hospitality of the residents, all contributed to the splendid success of this year's gathering. R. NATOLI.

THE NATURE-STUDY EXHIBITION.

THROUGH the kindness of the Civil Service Commissioners and His Majesty's Office of Works a Nature-Study Exhibition was held at Burlington Gardens from October 30 to November 3. In the absence of Lord Avebury, chairman of the committee, Sir Henry Howarth presided, and Sir John Cockburn declared the exhibition open.

It may at once be said that the object of the undertaking was to put into effect, forthwith, the lessons learned from the exhibition held last year at the Royal Botanic Gardens. There, through the energy of Mr. J. C. Medd, for the first time were brought together all the various methods and matters which have been taken or mistaken for nature-study. It soon became obvious that much excellent science teaching on the one hand was masquerading under the title, and on the other that desultory collecting without rhyme or reason was a second claimant for it.

At the suggestion of Mr. Wilfred Mark Webb, honorary secretary of the Middlesex Field Club and Nature-Study Society, delegates from it and from the Selborne Society met to appoint a committee to organise an exhibition on definite lines. The area from which exhibits were invited was also restricted to a dozen or so counties within easy reach of London. Evidence of work was asked for which dealt with such observational teaching as should form part of the education of all. This, while serving as an excellent preparation for science, is scientific only as regards method and accuracy of treatment.

[1] The communications to the various meetings of which mention is made will appear in the *Actes* and the *Comptes rendus* of the Association, most of them *in extenso*. Thanks are due to MM. Pioda, Fischer, Keller and Dufour for information very readily given.

The exhibition has been exceedingly successful from an educational point of view, and the exhibits showed that the schools which contributed had entered into the spirit which guided the committee in the preparation of its prospectus and in the desire to demonstrate what nature-study really is.

The judges were Miss Hodgson, formerly of the House of Education, Ambleside; Mr. Jonas Bradley, famous for his outdoor school at Haworth, Prof. Haddon, Prof. Minchin, and Dr. Chalmers Mitchell. The awards were made in strict accord with the objects of the committee, and were given so as to mark the work of the schools which are on the right lines. Certificates of merit, the highest official award of the committee, fell to the lot of the Froebel Institute, Streatham High School, Dulwich High School, Queenswood School, Orlestone Board School, and the Training College for the Deaf, Fitzroy Square.

Not the least important part of the proceedings were the conferences, at which practical teachers not only described their methods, but also in some cases showed how they came to adopt them. Speakers were carefully chosen from among those who exhibited last year and whose work was well known to the executive committee, of which several members helped to organise the previous effort.

On the morning of Saturday Mr. Hedger Wallace, chairman of the executive, presided over a meeting at which Mr. Badley, of Bedales School, Mr. Harry Lowerison, of the Ruskin School Home, Miss Sillham, of the Froebel Institute, and Miss Ethel Webb, of Streatham High School, spoke. In the afternoon the chair was taken by Mr. Jesse Collings, who had something to say about the Bill which he has before Parliament to promote nature-study in elementary schools, more particularly with the view of improving our agricultural education. There is every hope, moreover, that his measure will be passed without opposition. During the afternoon Miss Alderton, of Stretton, Mr. Thomas, of Orlestone, and Mr. Dodgeon, of Burnley, described their work. In the evening Mr. Richard Kearton, who has done so much to change the taking of birds' eggs for the collection to the taking of them by the camera, showed the pick of his well-known studies of wild-life, and others that had not been seen on a screen before. Afterwards, as on the previous evening, Mr. Martin Duncan proved the great possibilities of the Urban Duncan micro-bioscope for recording natural history observations in the ordinary way and under the microscope.

On Monday Mr. Oliver G. Pike gave an illustrated lecture on birds in their homes, and later the Middlesex Field Club held a meeting. Mr. Hedger Wallace pointed out the great necessity for a field club which should deal with Middlesex, record the fast disappearing animals and plants, and organise a local museum. Mr. Henry Stevens showed a number of remarkable slides of animals and plants under control, and Mr. Wilfred Webb demonstrated, also by the aid of the lantern (kindly lent by the Royal Geographical Society), how much nature-study could be done in London, proceeding afterwards to touch on the work of schools throughout the country.

On Tuesday evening Mr. R. B. Lodge lectured on some suburban birds and beasts, while under the auspices of the Selborne Society Prof. Boulger and Mr. E. A. Martin spoke on subjects in character with the objects of the exhibition. Financially, also, the exhibition has been a success.

BOTANY AT THE BRITISH ASSOCIATION.

THE meetings of the botanical section at Southport showed no falling off in interest. The arrangements made by the local authorities were admirable, and there was a good attendance of British and foreign botanists.

In his presidential address, Mr. A. C. Seward, F.R.S., gave an able and comprehensive summary of the present state of our knowledge concerning the composition and distribution of the floras of the past, from the earliest records in the Devonian and Lower Carboniferous up to the dawn of the Cretaceous period.

The report of the joint committee of Sections K and L on the teaching of botany in schools was read and discussed. A summary of the recommendations will be found in the report of the education section. In an interesting discussion which followed the reading of the report in Section K, several botanists expressed their approval of the report, and it was suggested that it would be a good plan if the methods recommended could be tried by teachers and the results communicated to the committee.

The morning of September 11 was given up to a series of papers and a discussion on the subject of heredity. Mr. W. Bateson, F.R.S., in an introductory address on recent discoveries in heredity, gave an excellent account of Mendel's researches, and pointed out that we have now reached a stage at which, by the employment of these methods, the solution of problems in heredity becomes possible under certain conditions. He described many of his own experiments, and exhibited specimens of the results which he had obtained in the hybridisation of various species of plants and animals, all of which give strong support to Mendel's laws.

Miss Edith R. Saunders followed by an extremely lucid account of her recent work on cross-breeding in plants, and showed the results of some of her more striking experiments (*vide* Reports to the Royal Society, 1902).

Mr. C. C. Hurst read a paper on recent experiments in the hybridisation of orchids, in which he showed by means of some beautiful coloured drawings that, so far as the intermediate hybrids are concerned, the results are apparently consistent with Mendelian principles. Dominant hybrids are infertile, and in the case of false hybrids further research is necessary before any definite conclusions can be arrived at.

The morning of September 14 was devoted to a discussion on the origin of the Monocotyledons, introduced by Miss Ethel Sargant, whose work on this subject is well known (*vide* "Annals of Botany," 1903). Miss Sargant maintains that a careful study of the anatomy of seedlings in various families of Monocotyledons and Dicotyledons leads to the conclusion that the common stock from which they both spring was not only angiospermous in character, but that it was more like a Monocotyledon than a Dicotyledon.

Miss E. N. Thomas, who followed with a paper on the structure of the embryo sac and the phenomena of fertilisation, pointed out that the results obtained support Miss Sargant's view in so far as they indicate the existence of a great gulf between Angiosperms and all other groups of plants, whilst there is little, if any, distinction in these respects between Dicotyledons and Monocotyledons.

In the subsequent discussion Miss Sargant's views were freely criticised, but all the speakers agreed that this valuable contribution to a very difficult question opened up a very interesting field of investigation.

Prof. H. Marshall Ward, F.R.S., gave an account, illustrated by plans and lantern slides, of the new botanical laboratories at Cambridge. This large block of buildings provides ample accommodation for study in all departments of botany, and special facilities are afforded for original investigation. The university is to be congratulated upon so important a development of its botanical school. Prof. Lignier presented a paper on the flower of the Gnetaceæ, in which some interesting new facts were brought forward, and Dr. Lotsy gave an account of his work on parthenogenesis in *Gnetum ula*.

The semi-popular lecture was given on the afternoon of September 14 by Prof. J. B. Farmer, F.R.S., on stimulus and mechanism in organisation. In a very able address the lecturer discussed the various forms of stimuli and the nature of the processes involved, and endeavoured to trace a connection between the growth and structural differentiation of an organism and the response to definite stimuli acting on special kinds of mechanism.

On September 12 an excursion, under the leadership of Mr. Lomax, was made to the Clough Foot Colliery, and on Tuesday afternoon the vegetation of the sandhills was investigated under the leadership of Dr. Otto v. Darbishire and Mr. Henry Ball. In a paper which he had previously communicated to the section as a preliminary to this excursion, Dr. Darbishire pointed out that the sand dunes are encroaching on the grass land, and that, although they can be fixed by sand-loving plants, it is only temporarily, and psamma is commonly planted for this purpose. The plant societies in the various regions of the dunes are well marked, and include a number of extremely interesting

plants, one of which, *Pyrola rotundifolia*, var. *maritima*, is found in certain parts in great profusion.

Of the numerous other papers communicated to the section, reference can only be made to some of the more important.

Fungi.—Mr. B. T. P. Barker (Cambridge) gave an account of the ascocarp in Ryparobius. The ascogonium appears to be uninucleate at first, and immediately after contact with the antheridial branch contains two nuclei, either situated closely together or apparently fusing. Later most of the cells of the system of hyphæ, developed from the ascogonium, are uninucleate, but some contain two nuclei, which probably fuse and become the single nucleus of a young ascus. Associated closely with this single nucleus is a structure of variable shape which has almost as strong an affinity for stains as the chromatin of the nucleus itself. It appears to be of the nature of a vacuole and to be intimately concerned with the nutrition of the nucleus, which at this time is of a remarkably large size. The results obtained point to a close relationship between the genera Ryparobius and Thelebolus.

Mr. E. S. Salmon communicated the results of culture experiments with biologic forms of the Erysiphaceæ, which prove that under certain conditions a "biologic form" which in nature is restricted to the species of a certain genus of host-plants becomes capable of infecting species belonging to another genus, and species of plants which are immune in nature are able to be infected. The author considers that it is possible that in this change of infection-powers of biologic forms of parasitic fungi in consequence of injury to the host-plant an explanation may be found of the sudden appearance of disease on plants hitherto immune.

Prof. H. Marshall Ward, F.R.S., in a paper on Eriksson's mycoplasm hypothesis, showed by means of a series of microphotographs and drawings that this so-called mycoplasm consists of haustoria only, and that there are no grounds for believing that Eriksson's views are well founded.

Prof. T. Johnson communicated a short note on a willow canker which has been the cause of considerable damage in an osier holt in the west of Ireland.

Physiology.—Prof. Letts and Mr. J. S. Totton contributed a valuable paper on the occurrence of *Ulva latissima* and *Enteromorpha compressa* in sewage effluents, and on variations in the composition of the tissues of these and allied seaweeds. The view expressed by one of the authors in conjunction with another chemist, that the growth of *Ulva latissima* in quantity in a given locality is a sign of sewage pollution, has received remarkable confirmation by the occurrence of this seaweed and of *Enteromorpha compressa* in the Belfast sewage beds. The spores probably found their way into the sewage by leakage of sea water into the system. The percentage of nitrogen was found to be higher, especially in Enteromorpha, in the sewage specimens than in those taken from the sea or brackish water.

Mr. R. H. Yapp gave an account of his observations on fruit-dispersal in *Adenostemma viscosum*. This plant is a composite which is widely distributed in the warmer regions of the globe. The distribution of the fruit is brought about by a pappus which consists of stalked glands, composed of numerous capitate hairs, which secrete a copious viscid fluid. The movements of the pappus setæ are effected by a group of motor cells which forms a pulvinus at the base of the stalk of each gland.

Mr. Harold Wager described some experiments on the staminal hairs of *Tradescantia virginica*, from which it appears that the protoplasmic movement can continue for some days after the hairs are removed from the plant, even if they are completely embedded in vaseline. The author also described a method by which the nucleus of the cells can be stained by means of the coloured cap contained in the vacuole.

Mr. J. Parkin gave an account of his work on the localisation of anthocyan in foliage leaves. In young leaves, and in the autumn coloured leaves, the anthocyan is usually confined to the mesophyll; in mature leaves mainly to the epidermis, except when the colouring matter is only produced under exceptional conditions, when it is usually found in the mesophyll. The author concludes that the presence of anthocyan in the mesophyll seems to weaken somewhat the view that its function is to protect the chlorophyll by absorbing the destructive solar rays.

Anatomy and Cytology.—Miss Ethel Sargant and Miss Agnes Robertson read a paper on some anatomical features of the scutellum of Zea Maïs. They find that the epithelium of the scutellum in contact with the endosperm becomes folded into a number of gland-like structures in which traces of some kind of secretion are commonly found.

Mr. Arthur W. Hill (Cambridge), in a paper on the histology of the sieve tubes of Angiosperms, showed that the sieve plates of the mature sieve tubes are traversed by relatively thick slime strings, each being enclosed in a callus rod. In the radial and tangential walls the slime strings, which are grouped into oval or rounded pitted areas, are much smaller than those in the sieve plates, and some three to six strings are enclosed in a callus rod. Connecting threads also occur between the sieve tubes and companion cells. Between the sieve tubes and cambiform cells, and between the latter and the companion cells, the small groups of threads are found in small and deep pits.

Mr. J. Lloyd Williams (Bangor) read a paper on the alternation of generations in the Dictyotaceæ and the cytology of the asexual generation, in which he pointed out that the nuclei of the tetraspore plants have about thirty-two chromosomes, and that in the formation of the tetraspores these become reduced to sixteen. The sexual plants also have the reduced number. The evidence, therefore, shows that the tetraspore produces a sexual plant, whilst the oospore produces the tetraspore generation.

Mr. L. A. Boodle (London) communicated a short paper on the structure of leaves of bracken from different habitats. In a very exposed and sunny situation the leaves are hard and short, while in a well sheltered and shaded locality they are much larger and soft. Long sori and short sori are typical of the first and second situation respectively. The internal structure of the pinnules varies with the habitat in a corresponding manner; the presence of a continuous, or nearly continuous, hypoderm and the large amount of the palisade tissue formed distinguish the leaf of the exposed from that of the sheltered plant.

Ecology, Distribution, &c.—In addition to Dr. Darbishire's paper on the sandhills of Southport, several other papers of some interest were read in this section. Miss M. C. Stopes gave an account of the colonisation of a dried river-bed. The stream became dried up in April, 1901, and during the years 1901–1903 observations were made upon the plants found growing on the dried up mud. In 1903 these included eleven frequent semi-aquatics, of which four are locally dominant, and thirty-two frequent land plants, of which eight are locally dominant.

Mr. T. W. Woodhead (Huddersfield) described his methods of mapping the distribution of plants, and the anatomical variations produced in the leaves of certain plants grown under varying conditions in different plant societies. He showed clearly by means of photographs what striking variations may be produced in the undergrowth of a wood owing to the nature of the trees immediately above it.

Dr. F. F. Blackman (Cambridge) gave an excellent summary of modern views on the phylogeny of the Algæ, illustrated by diagrams.

Mr. A. W. Hill (Cambridge) gave an account of his recent expedition to Upper Peru, and Mr. W. Wilson communicated a list of some of the plants growing on the serpentine rocks of the north-east of Scotland.

Fossil Plants.—There were only two papers of any importance in this section. Mr. E. A. Newell Arber (Cambridge) communicated some interesting observations on homœomorphy among fossil plants. Among recent plants species of different descent may possess many closely identical characters as the result of adaptation to particular conditions of the environment. There is some reason to believe that similar cases may be found among fossil plants, and the author finds some ten genera and species in which this phenomenon occurs.

Mr. Seward communicated a paper by Dr. D. H. Scott, F.R.S., and Prof. F. W. Oliver on the seed of Lyginodendron, which was illustrated by some beautiful lantern slides.

Economic Botany.—Mr. E. T. Scammell read a paper on the forest resources of Australia available for British commerce. The forest areas of Australia comprise 107,037,000 acres of marketable timber, or nearly half the areas of the forest lands of Europe, excluding Russia. The timbers are

of many varieties, and some of them are of high commercial value. The chief of these are the eucalypts, of which there are more than 150 species. Besides the eucalypts there are many kinds of casuarinas (the Australian oak), some conifers (the Moreton Bay pine, the cypress pine, the brown pine, or colonial deal, and others), many acacias (the Australian wattle), Banksias, and numerous other varieties. The range of Australian wood at present available for British commerce is limited. Western Australia and Tasmania are the only States that have seriously dealt with the question of exporting timber or of using their forest resources as a valuable commercial asset.

Mr. W. Powell described a process for seasoning and preserving timber which appears to be at once simple and effective. The timber is treated with a dilute solution of sugar, in which it is boiled until the air in the interstices has been got rid of. The timber is then cooled and dried at a fairly high temperature. Timber treated in this way is much improved, the soft woods especially, both in hardness and toughness.

EDUCATION AT THE BRITISH ASSOCIATION.

THE educational science section has become the debating ground where educational principles can be discussed without reference to minor administrative details and class distinctions. Increased efficiency is the leading idea, and it is promoted by the expression of authoritative opinion from a platform of the British Association. Attention is there directed to matters requiring consideration by authorities responsible for educational work, and the directions in which progress can be most usefully made are afterwards indicated in reports presented by committees. The work of the section is thus both critical and constructive, and its sphere of influence increases in extent every year.

After the president's address on the morning of September 10, a discussion on school curricula was carried on throughout that day and the next. The material for discussion consisted of eight papers received from leading representatives of various branches of educational work in response to an invitation issued by the committee of the section. The papers were printed in full in the September number of the *School World*, and the authors are Prof. J. Adams, Prof. H. E. Armstrong, F.R.S., Miss S. A. Burstall, Mr. G. F. Daniell, Mr. W. C. Fletcher, Mr. T. E. Page, Mr. J. L. Paton, and Prof. Michael E. Sadler. The three main divisions of the subject were:—(1) General principles upon which a school curriculum should be constructed; (2) the education of girls; (3) commercial education. To concentrate attention upon specific points, several propositions were formulated, and the authors of the papers were asked to speak to them instead of reading the papers. The propositions which were laid before the meeting during the discussion, and received general assent, were as follows:—

(1) It is desirable that specialisation should be deferred to as late a period as possible in the school career, and that the early curriculum should be so arranged as to lay a good foundation in English subjects, with, say, drawing and elementary science.

(2) It is to be regretted that the influence of public school entrance and scholarship examinations encourages the premature devotion of too much time to classics; it would be desirable that the study of Latin should not be taken before, say, twelve years of age, and that the language teaching up to that time should be confined to the mother tongue and one modern language.

(3) That a large measure of practical instruction should be included in the school course, and that both literary and practical instruction should be given throughout and made interdependent.

(4) It is desirable that in organising the curriculum there should be some differentiation, especially in science, between courses of study for boys and those for girls, more particularly between twelve and sixteen years of age.

(5) That for all girls literary instruction is of the highest importance; at some period of their school life practical instruction in the domestic arts should be provided, based on and correlated with elementary science teaching.

(6) With the view of obviating over-pressure, injury to health and superficiality, girls who intend to proceed to college, or enter a literary profession, should in general remain at school until eighteen years of age.

(7) It is desirable that county and borough councils and other authorities offering scholarships for girls to enable them to proceed to college should not expect them to take up their scholarships before they reach the age of eighteen.

It is impossible to describe in a few words the many important opinions expressed in the papers and during the discussion, but there was general agreement that the development of intelligence and self-reliance is of prime importance. The discipline of scientific studies was generally recognised, and also the necessity of making courses of instruction more practical than hitherto; that is to say, pupils should be active rather than passive in their attitude towards knowledge.

This is the touchstone which will test the quality of all educational work, whether in the humanities or in science, but as science deals with things more than words, it has special claims for recognition in the school curriculum. Mr. Balfour a short time ago, in referring to the relative advantages of classics and science as school subjects, expressed himself as doubtful whether scientific studies could supersede with advantage the traditional course of classics in schools. In connection with his remarks, it is of interest to refer to the following statement made by Mr. A. C. Benson in the *School World* for October in continuation of the discussion on curriculum:—"I have taught classics at Eton for nearly twenty years to boys of every degree of capacity. I have found that as a basis for teaching able boys they are excellent. But the effect of the present crowded curriculum, with classics as the basis, upon boys of ordinary or limited capacity is so absolutely negative, from the educational point of view, that I should hold that it would justify almost any experiment being tried."

Here we have an acknowledgment by a teacher of exceptional experience and ability of the failure of classical instruction so far as the average boy is concerned. This in itself is sufficient to justify the plea of the reformer for a readjustment of school studies on a broader basis than that at present adopted. In the discussion on curriculum, Mr. T. E. Page, a representative of literary culture, asked what branch of natural knowledge men of science wished to be taught in schools, and urged that there was a diversity of opinion upon this matter. The answer is, of course, that the subject is not so important as the method. It matters little whether botany, physics, chemistry, or any other science subject is used as the basis of instruction provided that they are studied practically under encouraging conditions and in the spirit of scientific inquiry. What men of science urge is that scientific studies are capable of forming habits of mind—resourcefulness, perspicacity, enterprise and initiative—in a way which the traditional courses and methods have not accomplished in the past.

A general view of the work done by the late Dr. Gladstone in connection with the teaching of science in elementary schools is contained in the final report of the committee on that subject. The committee was first appointed in 1878, with Mr. Mundella as chairman and Dr. Gladstone as secretary, and since 1883 has been annually reappointed to continue inquiries on the subject then instituted. The chief work of the committee has been to watch and record the proportion of children examined in science subjects in elementary schools. There has, of course, been a decided increase in numbers, but when the character of the work which has been done is considered, the committee now reports that the progress made is undoubtedly unsatisfactory. It is beyond question that science has in no way taken its proper place in our system of elementary education. Here and there work of the very greatest value has been done, but such cases are all too rare.

The report concludes with the remark that, in view of the national importance of developing the scientific spirit in elementary schools, it is not too much to say that it is now the duty of the Association to intervene with constructive proposals which will promote such an object. Judging from the great success which has attended the labours of the committee on the teaching of chemistry in schools and the recent discussion on the teaching of mathematics, there can be little doubt that a general inquiry might now be undertaken with great advantage, and that proposals might be made which would be of the greatest value

in guiding educational authorities generally. A special committee has therefore been appointed to report upon the courses of experimental, observational and practical studies most suitable for elementary schools, and generally as to the steps which it is desirable to take to secure proper attention to and encouragement of such studies. All who have paid attention to the subject will probably agree that some organised effort should now be made to extend the teaching of scientific method.

The dangers of ill-considered schemes of science study were referred to by Prof. H. E. Armstrong in presenting the report of the committee on the teaching of science in elementary schools, and were emphasised by Prof. Marshall Ward in the subsequent discussion. The committee points out that education authorities, realising the value of nature-study as a means of training and a matter of interest, will force instruction in this subject in schools in which the teachers are quite unable to handle it effectively by reason of their want of scientific training and knowledge. It cannot be too strongly impressed upon the lay mind that unless nature-study is taken up as a subject by which the spirit of scientific inquiry is created and fostered, men of science have no sympathy with its introduction into schools.

The report on the teaching of botany in schools should do something to direct the nature-study movement along scientific lines. There is a tendency to consider that the demands of the advocates of nature-study in schools are met by supplying reading-books in which a variety of facts in natural history are described, and are accepted by the pupils on the *ipse dixit* of the author or the teacher who dispenses them. If that is to be the result of the movement, it would be just as well to read fairy tales or fiction, so far as the development of mental faculties is concerned. To be of any value as a training in scientific method, nature-study must not only create interest, but must also demand active work for a definite purpose from the pupils. The difficulties in the way of doing this under the present conditions of teaching in schools are very great, but unless this fundamental principle of scientific instruction is acted upon, nature-study will prove a snare and a delusion.

On the importance of studying plants alive and experimentally, the botany report expresses decided opinion. It is pointed out that scientific curiosity is better occupied in discovering how plants get their food, respond to stimuli, adapt their structures to new circumstances, contend with their rivals or enemies, and propagate their race than in learning Latin names for the shapes of their leaves or classifying species. Individual practical work is, in fact, the only way to gain useful scientific experience, for knowledge accumulated by a mere act of memory is feebly grasped and soon forgotten. Throughout all stages of instruction, observation and experiment in the laboratory and out of doors must be the method of study. Among the conditions of profitable object-lessons for children, the committee notes the following :—(1) Every pupil should have an object to himself, or at least be able to examine the object as long and as closely as he pleases. A drawing is not to be allowed to rank as an object. (2) Living and growing plants should be frequently observed. (3) The living plant should not only be studied in flower, but whenever the change of season brings on a new phase of growth. Fruits, buds, and seedlings are as important as flowers. (4) Experiment can hardly come in too early, and there is nothing else quite so stimulating. Even young children can appreciate the interest of a simple experiment, and they may be allowed to take part in it before they are able to conduct it themselves.

Where botany can be seriously studied, plant-physiology is recommended as the basis of work, on the ground of its great practical importance and of its special value as discipline when studied systematically. The seedlings of common garden plants are recommended as providing the best material for early lessons.

A course of lessons on seedlings can be so arranged as to lead the beginner to consider attentively the nutrition of a green plant, the adaptation of the plant to external circumstances, and the development of new parts. The course should bring in drawing to scale, the graphical representation of experimental results, the care of garden beds, the care of water cultures, and many other practical arts. It ought also to encourage the habit of close observation, the habit of methodically comparing structures which in different plants answer the same purpose, the love of experiment, and the unwillingness (so characteristic of the scientific mind) to accept any conclusion except as the result of an independent and careful judgment.

How school gardens can be made of value in connection with the teaching of botany is described in one section of the committee's report by Miss L. J. Clarke, whose work at the James Allen's Girls' School, Dulwich, has shown that botany can be made a practicable as well as practical school subject. Other sections of the report are devoted to school excursions, collecting—which is condemned when carried on for selfish ends and without any scientific purpose—initiative of the teacher, and the simplicity of appliances required for teaching purposes.

An interim report was presented by the committee on the influence of examinations on school curricula and of schools on university requirements. The report was drawn up by the chairman, Prof. H. E. Armstrong, and consisted of expressions of opinion received from heads of schools, university tutors, &c., upon subjects to which their attention was invited. While pointing out the many evils which attend examinations, the majority of the persons who favoured the committee with replies took the view that in some form they are necessary. It is generally recognised that there has been a marked tendency to develop and improve examinations of late years. Among other results of the inquiry the following are noteworthy :—The effect of specific examinations, both as affecting general training and as encouraging undue specialisation, either on the humanistic or on the scientific side, was considered to be bad in most cases. Opinion was practically unanimous as to the need of unifying examinations with the object in view, among others, that certain examinations may serve a common purpose, *e.g.* as qualifying examinations for entrance upon a course of professional study.

The need of preventing examinations from becoming stereotyped and behind the times, and thus discouraging the development of new or improved methods, was another subject submitted for opinions, and the replies expressed the general desire that examiners should confer with teachers in some organised way.

With regard to the possibility of arranging outside examinations so as to test what has really been taught in the school, leaving the teachers a freer hand than in the past and arranging for their cooperation on the examining board, in the setting of the questions, and in considering the answers, there appeared to be a strange disinclination to insist that the teacher should be trusted.

The extent to which certain subjects are to be regarded as necessary and others as optional evoked diverse expressions of opinion, and the general conclusion seemed to be that entrance examinations at Oxford and Cambridge do not tend to promote a good all-round education.

The report of the committee on the conditions of health essential to the carrying on of the work of instruction in schools consists almost entirely of two reports of subcommittees on (1) the essentials of school buildings; (2) eyesight in school children. The report of the subcommittee on the former subject forms a condensed *résumé* of scientific principles of school construction of a very practical character. It may be regarded as a contribution toward the realisation of the proposal that a short practical treatise should be drawn up by the committee. Its conclusions are of a general character, and are applicable to all classes of school buildings. The subcommittee on eyesight in school children has dealt with and reported on (*a*) the causes of defective eyesight in school children, and (*b*) the conditions requisite for preserving eyesight from injury in school life. Besides dealing with general principles involved, it makes some practical recommendations of much importance. One of these is that it should be required that school books should be "passed" in respect to their typographic standard and quality by some recognised hygienic authority before being adopted in schools. The necessity for a very considerable eye-working distance in all the exercises and instruction imposed upon young children is a condition which lies at the root of school hygiene.

There was a useful discussion on the teaching of geography at a joint meeting with the geographical section, but as a short account of this has already appeared in the report of the proceedings of that section, no further reference need be made to it here.

R. A. G.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—Mr. T. H. Havelock, Smith's prizeman and Isaac Newton student in astronomy and astronomical physics, 1902, was on November 2 elected to a fellowship at St. John's College.

Mr. J. M. Dodds, Peterhouse, has been appointed chairman of the examiners for the mathematical tripos.

The university contribution from the incomes of the colleges has been fixed for the year at $12\frac{1}{3}$ per cent. This will yield the sum of 28,076*l.* to the common university fund.

The council of the Senate has proposed that a syndicate be appointed to consider whether it is expedient to make any changes in the present system of studies, teaching, and examinations of the university. It has been urged, it is said by His Grace the Chancellor, that some changes are desirable, especially as regards modifications of the requirements concerning the classical languages, and enlargement of the range of modern subjects. The reorganisation of secondary education throughout the country, and recent developments in other universities, have made the inquiry more than ever desirable.

IN small schools with limited accommodation, where instruction is given in both chemistry and physics, it is almost impossible to have separate laboratories for practical instruction in these subjects. Messrs. F. E. Becker and Co., of Hatton Wall, London, are manufacturing a combined bench for chemical and physical experimental work which succeeds in overcoming this difficulty. When the benches are required for a chemistry class there are shelves for bottles of reagents on much the same plan as in ordinary chemical laboratories, but when the benches are to be used for practical physics, the shelves and reagents can be safely lowered bodily until they are below the surface of the bench. The lowering is effected by weights, heavier than the shelves and their contents, attached to sash cords running over pulleys. This plan is a decided improvement upon the attempt to make the reagent shelves of such a pattern that they may be lifted when the benches are required by students of physics.

A COURSE of eight lectures on the fossil reptiles of South Africa was commenced by Prof. H. G. Seeley, F.R.S., at King's College, Strand, on Tuesday, and will be delivered on alternate Tuesdays until February 23, 1904. The lectures are addressed to advanced students of the University of London and others interested in zoology and palæontology, and to persons specially interested in the South African colonies. There is no fee for the course; cards of admission may be obtained on application to the academic registrar of the university. Other courses of special lectures in advanced zoology have been arranged, including the following, to be delivered next year:—Prof. E. A. Minchin, "Sporozoa"; Dr. P. Chalmers Mitchell, "The Structure and Classification of Birds"; Dr. C. W. Andrews, "The Fossil Vertebrates of Egypt and their Relations with those of other Regions"; Prof. H. G. Seeley, F.R.S., "The Forms of the Skull in the Extinct Reptilia" and "The Limbs and Arches which Support them in some Extinct Vertebrata."

THE Chester Society of Natural Science, Literature and Art, which now numbers more than a thousand members, held its thirty-second annual conversazione on October 22, when the Kingsley memorial prizes for nature-study offered for competition by the Chester Society were presented by the Duchess of Westminster. These prizes, of the value of a guinea each, are offered to boys and girls residing in Cheshire and North Wales, and this year the subjects selected for the competition were:—the life-history and habits of the common house sparrow; the collection of dried and mounted specimens of British grasses; the physical geography and natural features of the district in which the competitor resides; and a descriptive list of insects which are injurious to plants in the district in which the competitor resides. So far as practicable, the list of insects was to be accompanied by actual specimens of the insects tabulated. This plan, which the Chester Society of Natural Science has found successful in developing an interest in nature-study in the schools of Cheshire and North Wales, might with advantage be adopted by field clubs and natural history societies in other parts of the country.

AT Liverpool on October 31 Lord Londonderry opened a new wing erected in connection with Edge Hill Training College at a cost of 11,800*l.* Lord Londonderry, in the course of his address, said the universities were undertaking new and remarkable phases of work. Liverpool, Manchester, and Birmingham, which twenty years ago could not stand alone, were now eager for independence, and were anxious to discharge in their own way the duties of higher education. To be successful we must have an education system second to none. We had a considerable amount of leeway to make up, because we had not at the present time the advantages which were enjoyed by other countries in regard to this question. He wished it were possible that they could at once take the steps necessary to compete successfully and in friendly rivalry with other countries, but he trusted the day was not far distant when that might be done. It was the work of colleges which might induce the country at some future date to devote a sum of money annually to assist picked men and women engaged in research studies thoroughly to complete their education. He must not, however, be understood to be making any pledge that he had any such prospect in view.

THE classes at the Northern Polytechnic have for the last few years been greatly crowded, especially in physics, chemistry, and some of the trade subjects. To provide the necessary accommodation a large new wing has been constructed, to which the physics department has been transferred. This is now provided, amongst others, with three large laboratories, two of them 50 feet by 30 feet, and a lecture room that will seat about 100. On the top floor, in addition to the accommodation for chemistry already existing, are now added a large elementary laboratory, a laboratory specially fitted for honours students and research work, as well as a balance, a lecture room, and a fire-proof room. The new wing also contains a drawing office 50 feet by 30 feet, and four trade shops, for plasterers, masons, bricklayers, and painters respectively. The cost of this wing, with its equipment, has amounted to about 16,000*l.* The chemical laboratories, drawing office, and several trade shops are lighted by "inverted arcs," that is, by the light reflected from the ceiling only, upon which the arc lamps are caused to shine. The result is a light so diffused as to be almost shadowless, and therefore an exceedingly pleasant light for mechanical drawing and such things as masonry, in which there may be a lot of undercut work, which an ordinary light would make difficult. This wing was formally opened on Wednesday, October 28, by Lord Londonderry. Sir Arthur Rücker, Mr. Sydney Webb, and Sir Joseph Savory were among the speakers.

THE second article by a special *Times* correspondent on the work of the Mosely Educational Commission, published in the issue for October 28, contains several useful and suggestive expressions of opinion as to certain of the causes for the greater educational enthusiasm in the United States as compared with that in this country. The article states that "in England every penny spent on education is too often grudged; in America there is no public expenditure that seems to meet with more universal approval." Perhaps, the article continues, it is this belief in education for its own sake that has saved America from the whole system of examinations, scholarships, and prizes, under which English education groans. In our elementary schools the examination fiend has been partly exorcised, with the result that at this moment elementary education in England is in a healthier and freer condition than that of the secondary schools and universities. There, where education ought above all to be free to develop itself in the best methods and from the highest motives, the case is notoriously the reverse. From the time he enters a preparatory school until he leaves the university, an English boy imbibes the idea that the principal object of study is to pass examinations. Teachers must repress individuality of treatment, and with one eye on the nearest impending examination must think less of educating their pupils than of cramming them. Secondary schoolmasters dare not travel outside the require-

ments of university scholarship examinations, while preparatory schoolmasters must adapt their teaching to the competition for entrance scholarships at the secondary schools. Our whole system of higher education has got into a vicious groove of incessant competition. If the Commission succeeds in its mission, which is to stir up Englishmen to greater educational endeavour, it will have performed a great national service.

LECTURING on "The Work and Aims of the London University" on Monday evening at the London Institution, Sir Arthur Rücker remarked that a modern university had to concern itself with teaching, with research, and with technology. The London University was bound by its statutes to organise, improve, and extend higher education within a radius of thirty miles of the university buildings, but it started on this great task very sparsely equipped with funds. The Government gave a dignified centre in the Imperial Institute buildings and 8000*l*. a year, which was calculated to supply the actual needs of the university for the central staff and for carrying on the examinations, leaving the sum of 1500*l*. yearly with which to improve, organise, and extend higher education in London and thirty miles around. However, the London County Council put aside an annual grant of 10,000*l*. for the university, and that had enabled it to start from the first as a teaching university. It was essential, in carrying on the work, that the efforts of the university should at particular times be concentrated on particular objects, and at present three schemes had been proposed. The first of these was the incorporation of University College, which has offered to place its whole property at the disposal of the university and under its control. In order to carry out this scheme 200,000*l*. was needed to make the college ready for incorporation. The Drapers' Company had given 30,000*l*. for this object, and altogether about 100,000*l*. had been raised. But the scheme was delayed for the want of another like amount. The second scheme was connected with the great medical schools of London. They were at present hampered by the necessity of providing education in subjects such as physics and chemistry, which could be equally well taught at a distance from a hospital, and they were anxious that the university should undertake the whole of that work. This proposal would coordinate teaching in London, and a beginning could be made if 100,000*l*. were provided. The third scheme was that of a new college of technology proposed by Lord Rosebery. Large sums had been promised by private donors for this purpose, and the County Council had promised 20,000*l*. a year as an endowment if certain reasonable conditions were fulfilled. It was understood that about 100,000*l*. more was needed to carry out this plan also. Upon the carrying out of these schemes depended, among other things, whether the university was to be in reality a great teaching body or not.

SOCIETIES AND ACADEMIES.

LONDON.

Physical Society, October 23.—Dr. R. T. Glazebrook, F.R.S., president, in the chair.—The bending of magnetometer deflection-bars, by Dr. C. **Chree**. A theoretical paper contributed to the Society by the present author in May, 1901, proved, amongst other results, that the bending of the deflection-bar of an ordinary magnetometer, under the combined weight of the bar and its load, must increase the distance between the deflecting and deflected magnets, during a determination of horizontal force, to an extent which is not negligible. This conclusion has been borne out by direct observations made at the National Physical Laboratory on a number of magnetometer-bars, including specimens from the leading makers. The mean results thus obtained are recorded in the present paper. In many magnetometers the increase in distance due to the bending is roughly proportional to the distance itself. In the case of bars by the Cambridge Instrument Company, the bending increased the distance by almost exactly 1 part in 10,000 at all distances. It is hoped that the method employed will prove useful to magnetic observers who have not ready access to a physical laboratory.—On the magnetism of basalt and the magnetic behaviour of basaltic bars when heated in air, by Dr. G. E. **Allan**. Bars cut from basalt obtained from Rowley Regis and from Linz, Germany, were tested by means of a magnetometric method to determine their magnetic properties at temperatures from 15° to 800° C. Hysteresis curves are given, and the temperature-permeability curves show that whilst the English basalt has, in general, a maximum permeability near 500° C., followed by a minimum about 550° C., the temperature of maximum permeability in the case of the German basalt lay in the neighbourhood of 50° C., there being a subsequent gradual loss of strength with rise of temperature. Sections of heated and unheated rocks are given, showing evidence of chemical change in some of the rock constituents, and a table of values of susceptibility of the specimens is appended.

Royal Microscopical Society, October 21.—Dr. Hy. Woodward, F.R.S., president, in the chair.—Mr. J. W. **Gordon** exhibited some photomicrographs of *Pleurosigma angulatum*, taken with a 1/14th inch oil immersion objective, the magnified image being received on an oscillation screen; the image so obtained was further magnified 150 times by a second microscope placed above the first, the arrangement being similar to that exhibited and described by Mr. Gordon when he read his paper on the Helmholtz theory of the microscope. The photograph was then enlarged by the usual process. The source of illumination was a pin-hole lighted by a Welsbach burner, but Mr. Gordon thought it would be better to use a lime-light for the purpose, as the threads of the mantle produced a somewhat striped effect, which rather impaired the appearance of the photograph.—Mr. C. D. **Soar** exhibited on the screen by means of the epidiascope a large number of drawings of British water mites, one or more species of each genus being included in the series. He gave a brief explanation of the special characters of each species shown.—A paper by Mr. F. W. **Millett**, being part xv. of his report on the Foraminifera of the Malay Archipelago, was taken as read.

Challenger Society, October 28.—Sir John Murray, F.R.S., in the chair.—Dr. R. N. **Wolfenden** read a paper on the distribution of the Copepoda as illustrated by his cruises from Valentia to the Færöe Banks and in the "cold area" of the Færöe Channel. Two species proved to be purely epiplanktonic, both in the warm and cold areas, twelve were eurythermic and eurybathic, ranging from the surface to 700 fathoms in both areas. Forty-seven out of sixty-four in the warm Atlantic, and twenty-three out of forty-seven species in the cold area, were mesoplanktonic, and not met with in the adult condition at less than 200 fathoms, although some few were epiplanktonic when young. No less than thirteen species were captured at 1000 fathoms. There is evidence that certain forms are confined to the bottom, and form part of a true hypoplankton (in the sense in which that word was originally introduced); mesoplanktonic forms are found among these latter.—Dr. E. J. **Allen** contributed notes on the changes observed in the water temperatures and plankton southwest of the Eddystone.—Mr. L. A. **Borradaile** exhibited and made remarks on symbiotic crabs from the Maldive Islands.—Mr. **Bidder** showed and explained a new meter for bottom currents.

PARIS

Academy of Sciences, October 27.—M. Albert Gaudry in the chair.—On the scintillating phosphorescence presented by certain substances under the action of the radium rays, by M. Henri **Becquerel**. By working with the radium emanation in a strong magnetic field it was clearly proved that it is the α rays which cause the scintillation, this result being in agreement with the suggestion of Sir W. Crookes: the phosphorescence excited by the β rays, when it is appreciable, masks the effect of the α rays. The double sulphate of uranium and potassium is rendered phosphorescent by the β rays, the platinocyanide of barium by both α and β rays, whilst hexagonal blende and diamond are especially affected by the α rays, the phenomenon being very brilliant with the diamond. The facts observed are all in accordance with the hypothesis that the scintillation is due to cleavages irregularly provoked on the crystalline

screen by the prolonged action of the α rays.—Observation of the eclipse of the sun of September 20, made at the island of Réunion, by MM. Edmond **Bordage** and A **Garsault**.—Observations of Mars made with the large telescope of the Observatory of Meudon, by M. G. **Millochau**. The appearance of the markings on the planet when viewed through the large instrument differs in some respects from the previous observations made with smaller telescopes. Four drawings accompany the paper, showing the appearance on different dates.—On the groups of transformations of linear equations of finite differences, by M. Alf. **Guldberg**.—On the practical solution of equations, by M. **Rabut**.—The experimental determination of the momentary pressure resulting from shock, by M. **Ringelmann**. The results obtained can be expressed by the formula $C = kPv$, in which C is the momentary pressure, P the weight of the falling body, v its velocity, and k an experimental coefficient, 13·55.—On a capillarimeter, by MM. E. **Tassilly** and A. **Chamberland**. The instrument consists of a biconcave cylindrical lens, on the plane edges of which two plane parallel plates are clamped, the difference in the heights of the meniscus on either side being measured.—The change of electrical resistance of selenium under the influence of certain substances, by M. A.-B. **Griffiths**.—On the fusibility of mixtures of sulphur and bismuth, by M. H. **Pélabon**. The fusibility curve is represented by three straight lines, with two points of inflection, one at 435° C. and the other at 685° C., the latter corresponding to the sulphide BiS.—The action of boric acid upon iodides; its use in the separation of iodine from iodides in the presence of bromides and chlorides, by MM. H. **Baubigny** and P. **Rivals**. Iodine can be separated from a mixture of haloid salts by distilling with boric acid and manganese peroxide in a current of air.—On the composition of the prehistoric bronzes of Charente, by M. **Chesneau**.—The calculation of the heat of combustion of organic acids, their anhydrides and esters, by M. P. **Lemoult**. By assuming certain thermal values for the (CO.OH), (C=C), (CO.O.CO), and (CO.O.C) groups, a general formula is given for the heat of combustion of the above named substances. On 450 cases examined, in 12 per cent. the approximation is within 1 per cent., in·20 per cent. between 1 and 0·5 per cent., and in 68 per cent. within 0·5 per cent. of the experimental values.—Researches on isoglucosamine, by M. L. **Maquenne**. Isoglucosamine is reduced by sodium amalgam to two stereoisomeric bases, one being *d*-glucamine, the other *d*-mannamine. Isoglucosamine thus furnishes a new means of passing from the mannite to the sorbite series.—The action of chlorine on barium acetate, by M. Albert **Colson**. A chloroacetate is formed of the composition $[BaCl.(C_2H_3O_2)+H.(C_2H_3O_2)]$.—Solid azo-colouring matters derived from α-amino-anthraquinone, by M. Charles **Lauth**.—Study of some ancient samples of bread. An examination of bread from Pompeii, Aosta, Egyptian tombs, and the lake dwellings of Neuchatel, by M. L. **Lindet**.—The tectonic structure of the island of Eubea, by M. **Deprat**.—Study of the muscular contractions and of the reflexes in *Stichopus regalis*, by M. Victor **Henri**.—On the stimulation of nerves and muscles by discharges from condensers, by M. J. **Cluzet**.—The seat of epileptiform convulsions, by M. Nino **Samaja**.—A new dental and surgical drill, by MM. J. **Bercut** and A. **Donat**.—On the curve of output of a subterranean spring, by M. Edmond **Maillet**.

DIARY OF SOCIETIES.

THURSDAY, NOVEMBER 5.

CHEMICAL SOCIETY, at 8.—Conductivity of Substances Dissolved in Certain Liquefied Gases. Preliminary Notice: B. D. Steele and D. McIntosh.—The Reduction of Hydrazoic Acid: W. T. Cooke.—The Behaviour of Metallic Oxides towards Fused Boric Anhydride: C. H. Burgess and A. Holt, Jun.—Some Reactions of Vanadium Tetrachloride: B. D. Steele.—Studies on Comparative Cryoscopy. Part I.: The Fatty Acids and their Derivatives in Phenol Solution: P. W. Robertson.—The Vapour Pressures of Sulphuric Acid Solutions. Preliminary Note: B. C. Burt.—The Viscosity of Liquid Mixtures. Preliminary Note: A. E. Dunstan and W. H. C. Jemmett.—Additive Compounds of s-Trinitrobenzene and Alkylated Arylamines: H. Hibbert and J. J. Sudborough.—A Contribution to the Study of the Reactions of Hydrogen Peroxide: J. McLachlan.—The Constitution of Certain Silicates: C. Simmonds.—Constitution of Ethyl Cyanacetate. Condensation of Ethyl Cyanacetate with its Enolic Form: P. Remfry and J. F. Thorpe.—Interaction between Chloric and Hydriodic Acids: J. McCrae.—3:5:-Dichloro-1:1:2-Trimethyldihydrobenzene. A Correction: A. W. Crossley.—The Estimation of Hydroxylamine: H. O. Jones and F. W. Carpenter.—A Study of the Isomerism and Optical Activity of Quinquevalent Nitrogen Compounds: H. O. Jones.—The Action of Water and Dilute Caustic Soda Solutions on Crystalline and Amorphous Arsenic: W. T. Cooke.—The Union of Carbon Monoxide and Oxygen, and the Drying of Gases by Cooling: A. F. Girvan.

RONTGEN SOCIETY, at 8.30.—President's Address.

LINNEAN SOCIETY, at 8.—On the Structure of the Leaves of the Bracken, *Pteris aquilina*, in relation to environment: L. A. Boodle.—On the Life-history of a New Monophlebus from India, with a Note on that of a Vedalia predaceous upon it; with Remarks on the Monophlebinæ of the Indian Region: E. P. Stebbing.

FRIDAY, NOVEMBER 6.

GEOLOGISTS' ASSOCIATION, at 8.—Conversazione at University College.

TUESDAY, NOVEMBER 10.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—North Polar Exploration, 1898–1902: Commander R. E. Peary, U.S.N.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Tensile Tests of Mild Steel, and the Relation of Elongation to the Size of the Test-bar: Prof. W. C. Unwin, F.R.S.

ANTHROPOLOGICAL INSTITUTE, at 8.15.—Exhibition of Pictures Painted by Colour-blind Persons: Dr. F. W. Edridge-Green.—The Survival of Primitive Implements in the Færöes and Iceland: N. Annandale.—Anthropological Notes on Kikuyu and Kamba: H. R. Tate.

THURSDAY, NOVEMBER 12.

MATHEMATICAL SOCIETY, at 5.30.—Annual General Meeting.—On Sequences of Sets of Intervals containing a Given Set of Points: W. H. Young.—On Spherical Curves: H. Hilton.—On the Weddle Quartic Surface: Dr. H. F. Baker.—A Formal Generalisation of Maclaurin's Theorem: Rev. F. H. Jackson.—Diffraction: W. H. Jackson.—A General Theorem concerning Absolutely Convergent Series: G. H. Hardy.—Note on Borgnet's Method of Dividing an Angle in an Arbitrary Ratio: Prof. J. D. Everett.—On an Expression of the Electromagnetic Field by Means of Two Scalar Potential Functions: E. T. Whittaker.—The Propagation of Wave-motion in an Isotropic Elastic Solid Medium: Prof. A. E. H. Love.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Inaugural Address by the President, Mr. Robert Kaye Gray.

FRIDAY, NOVEMBER 13.

ROYAL ASTRONOMICAL SOCIETY, at 5.

PHYSICAL SOCIETY, at 8.—(1) Means for Electrifying the Atmosphere on a Large Scale: (2) an Arrangement for driving Mercury Pumps: Sir Oliver J. Lodge.

CONTENTS.

THURSDAY, NOVEMBER 12, 1903.

THE SCIENTIFIC WORK OF THE IMPERIAL INSTITUTE.

Imperial Institute: Technical Reports and Scientific Papers. Edited by Wyndham R. Dunstan, M.A., F.R.S., with a preface by the late Sir Frederick Abel, Bart., G.C.V.O., K.C.B., F.R.S. Pp. xlvii + 613. (London: Imperial Institute, 1903.)

OF the several purposes which the Imperial Institute was designed to serve, there is probably none which has been less regarded by the general public than that of scientific and technical research. Such work, however, was definitely one of the objects the advisory committee had in view when considering the proposed building some seventeen years ago; for, as the late Sir Frederick Abel has recorded, this committee was of opinion that the Institute would " afford accommodation for comparing and examining samples by the resources of modern science." In the furtherance of this design there has been gradually evolved an experimental branch, which eventually became known as the " Scientific and Technical Department " of the Institute. At the present time the staff includes ten assistants under the direction of Prof. Dunstan, and the chemical laboratories entirely occupy the upper floor of one wing of the Institute buildings, whilst the help of outside specialists, manufacturers, and commercial experts is invoked as occasion requires.

How this department struggled into existence is described by Sir Frederick in the preface to the volume under notice. It is rather pathetic reading sometimes. There was a difficulty in making any start at all, and to satisfy the " eternal want of pence " afterwards was a harder task still. Hat in hand the committee had to go, begging for money here and for professional help there, first getting, for example, " rupees to the value of 64*l*. 8*s*. 2*d*." from the Indian Government; then a grant of 300*l*. from the Commissioners of the 1851 Exhibition; next, " small gifts of money, and of some indispensable instruments " from such well-wishers as Sir Lowthian Bell and Dr. Mond; then a donation of 1000*l*. from the Goldsmiths' Company; and so on. How often, in those days, must the organisers have sighed for a sympathetic millionaire! Still—*solvitur laborando*—the thing was eventually done, and in 1896 the department, now on something like a stable footing, was taken in charge by Prof. Dunstan as director.

For the subsequent maintenance of the laboratories thanks are largely due to the Commissioners of the Exhibition of 1851. Acting with a wise liberality, the Commissioners in 1896 made the department a grant of 1000*l*. *per annum* for a term of years, and to this was added a second grant of a like amount two years later. In view of the work accomplished, this contribution of 2000*l*. *per annum* has been continued, and is still enjoyed by the department.

One question, however, may naturally be asked in connection with this matter. Should not the Government, now that it has taken the Institute under its wing, be induced to place the scientific department on a permanent footing—or at least to become wholly responsible for its support? There appears to be no reason why the Commissioners of the 1851 Exhibition should still assist in carrying on the work.

What has been accomplished by the scientific staff since 1896 is mainly set forth in the present volume. Part i. comprises a large number of technical reports upon various industrial products sent from India and the Colonies, with the view of ascertaining their commercial value and whether there was likely to be any market for them in this country or elsewhere. Minerals of several kinds (including coal, clay, iron-ores, and mica), fibres, oils, rubber, gums and resins, tanning materials, medicinal and food plants, timbers, and miscellaneous articles such as wines, aloes, and capsicums, have been examined and reported upon more or less exhaustively, with the practical result that in some cases a commercial demand has arisen for the article in question, and in others arrangements have been made for a regular supply of the substance, or, it may be, for its improved production and utilisation. Especially noteworthy would seem to be the recognition of *Caesalpinia digyna* as a tanning agent, and of *Podophyllum emodi* and *Hyoscyamus muticus* as sources of the drugs podophyllin and hyoscyamine respectively.

An interesting paper on the coal resources of India is included as an appendix to Part i. To those of us " who only England know," it may come as a surprise to learn that the coal output of the Indian collieries in 1900 exceeded 6,000,000 tons, or about 1/35th of that of the United Kingdom. In quality the coal is generally inferior by about 20 per cent. to that of this country, but on account of its cheapness it is largely used by steamships plying in Indian waters, and the output has increased six-fold since 1880. The supply is considered to be practically inexhaustible. Those amongst us whose geology is local rather than cosmopolitan will learn with interest that these immense Indian deposits are all of much later date than our own Coal-measures, for they occur in the Permian, Triassic, Jurassic, and even Cretaceous and Tertiary formations.

In Part ii. are collected some thirty-five papers of a more purely scientific character. These embody the results of special chemical researches upon various plant-constituents by Prof. Dunstan and his coadjutors, and of investigations into a number of colouring-matters, chiefly by Profs. Hummel and Perkin. Readers of the Chemical Society's publications will be familiar with most of these researches, all of which are interesting, whilst some are of particular importance. The investigations upon the constituents of Indian and American podophyllum, on the aconite alkaloids, and on cyanogenesis in plants may be specially indicated as good examples of the work which has been carried out. In some cases—as, for instance, in the paper on the action of alkyl haloids on aldoximes and ketoximes—it is not quite clear how the chemical question involved was connected with the special work of the Institute, but no doubt such general points would often arise during the progress of researches upon specimens forwarded for examination. On the whole, these " scientific papers " strike

one as being admirable descriptions of useful work, well conceived and ably executed.

As a separate establishment the Imperial Institute has ceased to exist, and is now a department of the Board of Trade. In its time it has played many parts. It has exhibited nuggets to us, sold us cakes and ale, discoursed sweet music to our ears, and charmed our eyes with its fairy-lamps and coloured fires. These things have vanished, as have also many of the splendid, but rather nebulous, generalities which we used to hear concerning the Institute's prospects and probable influence as a factor in Imperial affairs. But at least the definite work of the scientific staff remains, and, presumably, such services as those now rendered will be more and more brought into requisition as time goes on. It may well happen that Prof. Dunstan's laboratory will—to paraphrase a remark of Huxley's—become the forecourt of the temple of success for some at least of the original aims of the Institute, whatever may be the fate of the remainder.

C. SIMMONDS.

BABYLONIAN DEMONOLOGY.

The Devils and Evil Spirits of Babylonia. Vol. i. By R. C. Thompson, M.A. Pp. lxv+212; with 2 plates. (London: Luzac and Co.)

THE present volume is the first of two which Mr. Thompson intends to devote to a study of the evil spirits and devils of Babylonia, and it will, we believe, be welcomed by readers of many classes. We have been long familiar with the generalisations which writers are fond of making upon this fascinating subject, but so far as we know, no one has before attempted to give a systematic account of Chaldean demonology, and to add at the same time the reasons for the faith which is in him. Those who are interested in cuneiform decipherment will remember that some few years ago the Trustees of the British Museum began to publish a series of classified Assyrian and Babylonian texts, which they issued in parts, each containing 50 plates of text. The earliest parts contained all the material for the syllabary and grammar, then followed lists of words, and afterwards Mr. L. W. King's edition of the Creation tablets. In the present year were published the sixteenth and seventeenth parts of the series, which supplied copies of all the tablets relating to "evil spirits," "fever-sickness," and "headache," carefully made by Mr. R. C. Thompson, and these are the sources of the materials which have been translated in the present volume.

Mr. Thompson gives transliterations of his cuneiform texts on the left hand pages, and English translations on the right; this is an open and honest way of working, and we hope that English Assyriologists in general will follow his example. Nowadays the student demands facts, and the text is the greatest fact of all; no linguistic study can flourish upon bad foundations, and in our opinion the work of the man who hides his texts, or only makes them partially available for students, should be viewed with suspicion. Even a bad text is better than none, for at least workers in England, France, and Germany can correct it sooner or later. In the present case the British Museum publishes the texts, and Messrs. Luzac the translations, and as each portion of the work is done by the same man we are able to ascertain our position from a scholarly point of view to a nicety.

The publication of evil spirit texts, like so much else, was begun by the late Sir H. Rawlinson, K.C.B., and attempts were made to translate his copies first by Lenormant and secondly by Prof. Sayce. Sir H. Rawlinson, however, only published selections from the great mass of cuneiform literature in the British Museum, and it follows, as a matter of course, that even where they could translate the texts, the conclusions of Lenormant and Prof. Sayce were based on incomplete and insufficient evidence. The subject of Chaldean demonology is at the best a difficult one, and we have no hesitation in saying that the earlier works on it rather hindered than helped the understanding of the matter. Now that the tablets are joined up, and their right sequence found, it becomes clear that the Assyrian scribes were not so stupid as some have thought, and that there really was method in their madness.

It is to Mr. Thompson's credit that he has found out what the Assyrian method was in respect of the evil spirit tablets, and having found this his translations possess unusual value. He will hardly, we think, claim to have settled all the difficulties which he has encountered, but there is little doubt that his present work will form the standard one on the subject for many years to come. In the course of his study we find that he had destroyed a few ideals, and more than one favourite and popular theory. It was fashionable to assert a few years ago that the British Museum contained a tablet which bore on it an allusion to the Garden of Eden, but now that the fragment referred to has been put in its right order, we see that the text on it has nothing whatever to do with the Garden of Eden, and that the tree which was supposed to be nothing more or less than the Tree of Life is the *kishkanu* plant, which grew in Eridu, and was believed merely to possess magical properties. Mr. Thompson has taken great pains to thresh this matter out, and we think that he has proved his points very thoroughly. We can only hope that this exposure will deter that class of Assyriologist which seeks for reputation and popularity by the "finding" of "Biblical parallels" from continuing its charlatanic practices. More harm has been done to Assyriology by such things than by all the mistakes which its followers, from Rawlinson down to Thompson, have made; for even the results which are certain have been discredited by many first-rate Semitic scholars who were unable to read cuneiform.

Another important result of Mr. Thompson's work is the proof that, *au fond*, the demonology of the Semitic peoples of Mesopotamia who used the cuneiform system of writing is of Sumerian origin, and there is good reason to suspect that the greater part of Babylonian psychology and eschatology were borrowed directly from their non-Semitic predecessors in the country. This remark applies also to many of the beliefs which the Hebrews took over from the Babylonians their kinsmen. Want of space will not permit the mention

of many minor points of interest in the volume before us, but we hope to refer to the subject again when the second portion of Mr. Thompson's work appears. Meanwhile, the book may be commended to all students of folk-lore, as well as to the Semitic philologist and anthropologist.

LINE GEOMETRY.

A Treatise on the Line Complex. By C. M. Jessop. Pp. xv+364. (Cambridge: University Press, 1903.) Price 10s. net.

THE systematic study of what is now called line geometry was begun by Plücker in his "Neue Geometrie des Raumes." There was, it is true, a fairly complete theory of the linear complex due to Chasles and others before the publication of Plücker's work, and the geometry of systems of lines (congruences) has in some respects not progressed very much since the date of Kümmer's celebrated memoir, but it was only after the idea of line coordinates had been introduced that the essential qualities of the new geometry were recognised.

In his treatise on the line complex, Mr. Jessop has aimed at presenting the extensive investigations of German and Italian geometers in a form easily accessible to the English student of mathematics. It has been found necessary to write an introductory chapter on the elementary methods of synthetic geometry that are used in the book; then the next four chapters contain the theory of line coordinates, in the general form introduced by Klein, and the linear complex. A great portion of these chapters will be familiar to anyone who has studied the theory of forces in three dimensions with attention; the only omission that occurs to us is a number of easy exercises on the use of line coordinates, particularly in the ordinary Cartesian form, but this defect is partly remedied by an excellent collection of examples at the end of the book.

The theory of the quadratic complex is naturally the most important part of the book—the linear complex is too well known, and the higher complexes too difficult to deal with, to illustrate the methods of the subject. The author has devoted six ample chapters (vi.–xi.) to this theory. Chapter vi. deals mainly with the singular surface, which is remarkable in all complexes as being both the locus of singular points and the envelope of singular planes. Two proofs of the identity of this locus and envelope are given, one depending on von Staudt's theorem concerning a tetrahedron, and the other on infinitesimal properties. The first is particularly interesting although peculiar to the quadratic complex, because a tetrahedron being the simplest form of the singular surface, von Staudt's theorem is a particular case of a property of Kümmer's quartic from which the result follows; the other proof can be extended readily to any complex (chapter xvii.). The discussion of Kümmer's quartic is the author's own, and will be very welcome to the beginner as being both elementary and direct.

It is curious that an infinite number of quadratic complexes have the same singular surface, the theory being similar to that of confocal quadrics. Such cosingular complexes are discussed in chapter viii., and by developing the idea of corresponding lines in cosingular complexes Mr. Jessop has obtained some very interesting and novel proofs. Another chapter deals with the beautiful classification of quadratic complexes, and contains an exposition of Darboux's proof of the fundamental theorem of Weierstrass on the equivalence of quadratic forms.

In chapter vii. an account of some special complexes is given, the greater part of the space being devoted to the tetrahedral complex; this complex was studied long before the introduction of line coordinates, and lends itself readily to synthetic treatment.

In another part of the book it is shown that a tetrahedral complex can always be found which contains the complete intersection of a quadratic complex and a linear complex. Substantially this important result is due to Kümmer, but the first complete account of it we owe to Caporali.

Only two chapters on congruences appear in the work; this part of the subject is difficult, because the analytical methods are clumsy when applied to such congruences as are not complete intersections of complexes, and the purely synthetic methods of Sturm and others are extremely tedious. Mr. Jessop follows Kümmer on the general principles, and only gives a detailed account of the simplest congruence, namely, that of the second order and the second class.

The latter portion of the book does not strike us as being so attractively arranged as the earlier parts, but the final chapter on the connection of line geometry and differential equations is valuable as an introduction to Lie's theories.

There is no doubt that the book will be a boon to a student of the subject, and that anyone with a taste for geometry will find much that is interesting and something that is new in it. J. H. G.

OUR BOOK SHELF.

Geological Rambles in East Yorkshire. By Thomas Sheppard, F.G.S. Pp. xi+235; 53 illustrations and geological map. (London: A. Brown and Sons, 1903.)

THIS is a pleasantly written and attractive guide to the geology of east Yorkshire, the work of a sturdy local geologist who shows himself to be master of his subject and of the literature past and present. Under his enthusiastic leadership we are taken from Hull to the out-of-the-world promontory of Spurn Head, where we learn many lessons about recent geological changes. Thence we are conducted northwards to Withernsea and Hornsea, examining some of the finest sections in the Boulder-clay of Yorkshire; successive beds of drift with transported mollusca and Scandinavian rocks, deposits with local detritus, and others with rocks from the Cheviots and elsewhere. We see also lacustrine deposits and peat beds, remains of old lakes, of which Hornsea Mere alone appears to survive. Then we are taken on to Bridlington, noted for its shelly "Crag," really a part of the basement Glacial drift, which is now hidden behind a strong sea-wall. The buried cliff of Sewerby, with its basement clay and older mammaliferous deposit yielding *Elephas antiquus*, hippopotamus, rhinoceros, &c., claims attention. From this we pass on to the fine

Chalk cliffs of Flamborough Head, beginning near Sewerby with beds which are rich in sponges and yield also Marsupites, and we continue along the headland to lower divisions of Chalk at Selwick, Thornwick and Bempton, and finally to the base with its Red Chalk at Speeton. Here, amid a region of landslips, we notice one slip on the part of the author (p. 61), where he refers to the Red Chalk of Cromer, meaning, of course, Hunstanton. The Speeton Clay, as unravelled by Mr. G. W. Lamplugh, is duly described, from the Gault through the Lower Cretaceous which constitutes the Speeton Clay proper, to the Kimeridge Clay. From this tract we are taken to the Corallian rocks of Filey Brigg, and on to Gristhorpe and Scarborough, where the work of Mr. W. H. Hudleston and Mr. Fox-Strangways, as well as that of earlier geologists, is duly mentioned.

Thus all the Jurassic divisions are in turn described as we proceed along the coast, as the author takes us to the Lias of Robin Hood's Bay, Whitby and Redcar. He then brings us back to the Humber, discourses on the warp, which is material not carried down by the rivers, but derived from the waste of the Boulder-clay cliffs and brought in by the tide. From Hull again to Hessle we see more of Glacial drifts; we are taken over the Oolites of Brough and South Cave, and across the Yorkshire Wolds, the charms of which are well described, and thence we come back to Holderness.

The work is admirably illustrated with photographic views, many of them taken by Mr. Godfrey Bingley, and from its clear and accurate descriptions it is well calculated to rouse up and foster an interest in geology.

Les Produits coloniaux d'Origine animale (Bibliothèque Coloniale). By H. J. de Cordemoy. Pp. viii+396; illustrated. (Paris: Baillière et Fils, 1903.) Price 5 francs.

THE object of the series of which the volume before us forms a part is to bring before the French public in an interesting and popular style the origin of the foreign food supplies and products used in the arts and commerce, and more especially those which are yielded by their own colonies. The idea is an excellent one which might well be copied in this country, and, so far at any rate as the present volume is concerned, the Colonial Institute of Marseilles, to which the series owes its conception, is to be congratulated on the project.

The author of the present volume divides his subject into two main headings, the one including foreign food supplies and the other all colonial products of animal origin employed in French industries and arts. As regards the first section, attention is concentrated in one chapter on the manufacture of beef-essence in Madagascar and New Caledonia, while the second, and much larger one, is devoted to fish and fishing, and such special products as edible swallow-nests, bêche-de-mer, &c. The most valuable fishery appears to be that for thunny on the Tunisian coast, the concession for which is let to Count Raffo for forty years at an annual rent of 5400 francs. The most remarkable fishery at Tunis is that of octopus. Poor food one would think; but it appears that in Greece and Crete there are two annual fasts, during which the consumption, not only of meat, but of fish and the flesh of all animals "having blood is prohibited." As the octopus is not considered to come within this prohibition, it forms, in a dried condition, an important food supply during the seasons in question.

As regards the second and much larger section of the work, limitations of space render anything approaching a detailed notice an impossibility. It must suffice, therefore, to state that this section is subdivided into three groups. Under the first, which includes products used in leather and textile manufactures, as well as for dress and ornament, are classed silk, hides, furs, hair, wool, feathers, ivory, coral, sponge, tortoiseshell, mother-of-pearl, horn, &c. In the second group are ranged wax, fat, oil, gelatin, and perfumes; while the third and last group is devoted to resinous products, such as lac, and the dyes afforded by the cochineal insect and other animals.

While congratulating the author on the amount of information he has conveyed in a small space, and on the interesting manner in which this is described, we venture to think that the illustrations, some of which are too large for the pages, are hardly up to modern methods and requirements. R. L.

A Text-book of Botany. By Dr. E. Strasburger, Fritz Noll, H. Schenck, and the late A. F. W. Schimper. Second edition, revised with the fifth German edition, by W. H. Lang. Pp. ix + 671; with 686 illustrations, in part coloured. (London: Macmillan and Co., Ltd., 1903.) Price 18*s.* net.

THE new edition of the English version of the "Bonn Text-book" is based on the fifth German edition. It marks an improvement on its predecessor, and is brought well up-to-date as regards the text, whilst we also note an improvement in the figures, some of the older illustrations having been omitted or replaced by better ones. The coloured representations, however, do not strike us as very useful, and we would have willingly seen them disappear.

The principal innovation in the present volume consists in the inclusion of a bibliography, which, without pretending to be complete, cannot fail to be of use to the serious student who wishes to find his way about the literature of the science.

The popularity already enjoyed by this treatise (in spite of defects inherent in any attempt to compress a big subject into the narrow limits of a single volume) is well deserved, and Dr. Lang is to be congratulated on the excellence with which he has carried out his share in presenting the book to English students.

Bacteria in Milk and its Products. By Prof. H. W. Conn, Ph.D. Pp. vii + 306. (London: Rebman, Ltd., 1903.) Price 6*s.* net.

THIS little book gives an excellent account of the relation between milk and its products and bacteria and allied organisms. It is written in simple language, and might be read with profit by those engaged in the "milk" industries who have had little scientific training. After a few introductory pages upon the nature of bacteria, the bacterial contamination of normal milk is discussed, and plain directions are given for its reduction, milk vessels, water supply, milking, cooling, and the sanitary control of dairies being all dealt with. The various fermentations that occur in milk, milk from diseased cows, the sterilisation of milk, cream ripening, artificial starters, butter and cheese, are some of the subjects considered in later chapters, and the book concludes with directions for the bacteriological analysis of milk and for some of the simpler chemical determinations. A full bibliography is appended, but the titles are too contracted; in many instances it is difficult to recognise the publication to which reference is made.

R. T. HEWLETT.

Junior Algebra Examination Papers. By S. W. Finn. Pp. vi + 87. (London: Methuen and Co., 1903.) Price 1*s.*

THE seventy-two examination papers contained in this little book are modelled on questions set at such school examinations as the university locals. The questions are graduated, and full answers are supplied. A useful table of contents enables the teacher to discover rapidly the scope of the different test papers.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Hyksos-Hittites.

IN the *Times* of October 28 there appeared, under the signatures of Prof. J. M. Mackay, of Liverpool University, and Messrs. Percy Newberry and John Garstang, a letter on an important archæological subject, entitled "Etruscan and Hyksos—a Hittite Clue." The object of this letter appears to have been to prove a culture-connection in the second millennium, B.C., between the Etruscans in Italy, the Kheta or "Hittites" in Asia Minor and northern Syria, and the mysterious Hyksos or "Shepherd Kings" who invaded Egypt, and usurped its government between the thirteenth and eighteenth dynasties.

The subject is, of course, one of considerable interest, and the theory is a suggestive one, but readers of the *Times* would hardly guess from the tenor of this letter that the theory enunciated in it has been well known to all archæologists for the last fourteen years at least! In fact, the theory was adumbrated by several workers in the field of Oriental archæology before it was finally thrown into a concrete form and placed before scholars by Father A. C. de Cara, in the year 1889. As expounded by this learned Jesuit, the theory is simply repeated by the three writers of the letter already mentioned; hardly any original additions are made, and these are not of a character to command the adherence of students. For example, it is suggested, though not definitely said, that the well-known company of immigrants from Asia depicted on the walls of the tomb of Khnemu-hetep at Beni Hasan was a party of "Hittites." Unluckily, however, these people are Semitic in feature, and the name of their chief, Abesha, is, judging by all analogy, Semitic. Now we are quite certain that the features of the Kheta, and their names also, were non-Semitic. This Prince Abesha, the writers of the letter say, "is entitled the ruler of a foreign (mountainous) land—the Sinaitic deserts, it has been conjectured, to the south of Hebron, where Hittite and Semite had intercourse and intermarriage in the age of the Patriarchs." Here an unwarrantable assumption, and even this is not original, has been made, for there is no proof that the "children of Heth," who in the Bible are said to have lived near Hebron, are of the same race or nation as the Hittim of northern Syria, who are certainly to be identified with the Khatti of the Assyrian records and the Kheta of the Egyptian monuments, who were undoubtedly the builders of the great sanctuaries of Boghaz Köi and Eyuk, and to whom the inscriptions commonly called "Hittite" belonged.

The writers of the letter also show confusion of thought in the following matter. After stating that in the statues of Queen Nefert and Amenemhāt III. a clear Mongolian or Turanian strain is visible, and noting that "she wears on her head a horse-shoe-like attire, he a pigtail to his wig," they go on to say that the statues which the Hyksos made or usurped are Mongoloid, "Turanian on a Semitic stock, Hittite-Semite." The conclusion seems to be that these "Mongoloid" Hyksos had appeared in Egypt, and had assumed its government before the reign of Amenemhāt III., but the statues referred to are well known to belong to the reign of Amenemhāt, and were usurped by the Hyksos; therefore we have no proof whatever from the statues that the Hyksos were Mongols, and from this it follows that the "Mongoloid" Nefert and Amenemhāt III. cannot be proved to be Hyksos-Hittites. Further, the idea that the statues of Amenemhat's reign are Mongoloid at all is a pure matter of opinion, on which many archæologists would differ from the writers of the letter. The horse-shoe headdress of Nefert is an ordinary Egyptian woman's wig in the fashion of the twelfth dynasty, and Amenemhāt's pigtail is no proof that he was a Mongol; it might just as well be argued that Frederick the Great was a Mongol because he wore a pig-tail.

So much for mistakes. It is a matter for surprise that three writers who thought fit to send a communication to the *Times* on an important archæological matter should have been, as it appears, totally unaware of the long priority of another writer in the whole field of which their letter treats. X.

Telegraphic Disturbances in Spain on October 31.

ON Saturday, October 31, the telegraphic communication was interrupted almost from morning until late at night. The first sign of the perturbation was observed at 9h. 30m. in the morning (W.E.T.) in the form of continuous currents along nearly all the lines that start from Madrid. At first it was thought that some leakage from a cable in the vicinity of the Central Office was the cause of the phenomenon, but on making inquiries it was ascertained that the same occurrence was observed in Cordoba, in the line to Málaga. At the same time the cable from Vigo to Emden was rendered useless, and at Lisbon the phenomenon was observed at some moments in which the situation was normal at Madrid. The maximum intensity took place between 12h. 30m. and 15h.; at 21h. the phenomenon had nearly ceased.

During the first hours of the evening the currents were continuous for periods of twenty to thirty minutes in some of the wires, for instance, in those of Vigo; at 22h. the current in the Coruña wire was continuous during 3m.; at 1h 45m. of November 1 the current was also continuous in the Bilbao wire. At 3h. 20m. the cable from Cadiz to Tenerife in the Canary Islands remained perturbed so strongly that the clerks made the contact with the earth to avoid the discharges.

At 19h. communication between Madrid and Burdeos was re-established; information received at the Central Office stated that the cable from Senegal to Noronha was disturbed. In Spain, in some lines running approximately east and west, the phenomenon was not observed, namely, in the coast of Andalusia, from Málaga to Almeria, but in the line from Málaga to Granada, which runs roughly to the north, the perturbation was very marked, also in the more north-easterly line from Granada to Murcia. These three lines are approximately of the same length. In the centre of Old Castile, in the transversal line from Aranda to Ariza and to Valladolid, nothing abnormal was observed; meanwhile, in the general line that runs north-south, the disturbance prevented all communication. In the provinces of Cuenca and Extremadura, the lines of which run approximately east and west, the communications remained undisturbed.

The night was clouded, so that nothing could be seen of an aurora borealis, even if a display occurred.

AUGUSTO ARCIMIS.

Instituto Central Meteorológico, Madrid, November 3.

The November Leonids.

THERE appears to be little prospect of a brilliant recurrence of the November meteors on about November 15 next, though the moon will offer little impediment, being past the last quarter. The parent comet returned unobserved to perihelion in the spring of 1899, and is now far on its outward journey, beyond the orbit of Jupiter, so that any meteors appearing this year must be at a vast distance from the supposed derivative body. There is evidence, however, that minor groups circulate along the orbit, and that these are sufficiently condensed to produce pretty rich showers in certain years, as in 1879, 1888, &c. The system or stream is no doubt a continuous one, for every year at the middle of November some meteors of the swift, streaking class are seen shooting from the radiant in the "Sickle." It is obviously necessary, as a means to increase our knowledge of the shower, to watch for the display annually, and to record the time of its maximum and the observed horary number of its meteors.

The position of the radiant has been frequently determined in past years by eye-estimated meteor-tracks, and it now remains to obtain some further photographic records so that this feature may be more precisely ascertained. It is curious that the mean place of the radiant resulting from eye observations of meteors is nearly two degrees west of

the centre indicated by four photographic determinations of the radiant, the relative places being :—

	Radiant Point
From eye observations	$149^\circ.7+22^\circ.7$
From photographic trails	$151^\circ.5+22^\circ.2$.

Though there are now some hundreds of eye-estimated radiant points of this shower available for comparison, the resulting average place is not likely to be as accurate as the few positions obtained by photography. But even the centres derived from the latter method do not exhibit absolute agreement, the difference amounting to more than one degree in two of the cases.

It is hoped that the shower will be specially looked for on the mornings of November 15 and 16 if the atmosphere is favourable. W. F. DENNING.

Leaf Decay and Autumn Tints.

THE leaves of our forest trees at the period of the autumnal fall are not similar as respects the condition of vitality which they then have reached; that is to say, while some still retain their green colour and drop off, as it were, mechanically, the majority exhibit a change of coloration and are apparently dead or more or less decayed. The relation between these stages of vitality or decay and that of the particular colour (red, yellow, or brown) which the autumn leaves assume may be so far demonstrated by a critical scrutiny of certain constituents of the mineral matters (ash), especially the silica and lime, which they enclose at the very moment when this special and characteristic colour is displayed. In order to present to view this order of thought, the following tables of ash analyses are drawn up, the percentages being calculated on the red, yellow, or brown leaves with their petioles dried at 100° C., and on the ash minus charcoal :—

Leaves which become Red in Autumn.

	Percentage of ash	Constituents of the ash	
		SiO_2	CaO
Norway Maple	10·5	8·7	44
Wild Cherry	7·3	3·3	35·3
Rowan	8·6	3·4	41·4
Scarlet Oak (*Quercus coccinea*)	4·8	3	51
Dogwood	11·3	9·3	45·5
Elder	13·7	4·5	29·9

Leaves which become Yellow or Brown in Autumn.

	Percentage of ash	Constituents of the ash.	
		SiO_2	CaO
Wych Elm	16·8	28·8	40·8
Sycamore	12·1	20·7	41·9
Oak (*Quercus robur*)	6·35	13	44
Beech	6·3	23	32·6
Larch	4·6	19·4	27
Weeping Willow	10·3	10·9	37·5
Poplar	9·7	23	35·2
Hornbeam	12·5	42·2	24·4
Linden	8·9	22·2	35

Assuming that a heavy ratio of total ash and of silica therein is an indication that the life of the leaf is practically exhausted and its physiological energy at an end, we may, in view of the foregoing tables, consider two cases :—(1) where the percentage of silica is under 10 per cent., and (2) where the percentage of silica is 10 per cent. or more. It will be at once observed that every one of the leaves which turn red in autumn belong to the former category, while all those exhibiting yellow or brown tints and shades belong to the latter. This state of affairs would seem to hold good universally, provided only that the other conditions of the phenomena are equal. Hence a few other examples, such as the birch, the leaf of which, generally yellow, is occasionally dashed with red, or the ash-tree, the leaf of which has a small percentage of silica but a high percentage of ash, are omitted from the lists. Once upon a time I found some hazel leaves, which were almost as red as those of a wild cherry, to contain only about 9 per cent. of silica in the ash (whereas, according to De Saussure, it holds even as early as September 20, 22 per cent. silica). With regard to the exceptional instance of the yellow and never red ash-tree leaf, every plant analyst is aware how prone its tannic chromogen is to be, in certain circumstances, the precursor of a very dark brown shade, such as no other tree of our woodlands (except, perhaps, the holly) ever approaches. Eminently interesting and instructive is the contrast shown in the tables between the two maples as well as between the scarlet oak (*Quercus coccinea*), the magnificently tinted denizen of the American forest, and our own British oak (*Q. robur*), yellow and russet in autumn. It is known that the leaves of American maples, &c., cultivated in Europe do not exhibit such marked changes of colour, *i.e.* to rich deep scarlet, orange scarlet, deep rich purple, rich orange, dark crimson, &c., as they do in their own country. The causes of this difference are now pretty much made manifest. The soft, mild and yet glowing climatic conditions of the American woodlands sustain the vitality of the deciduous leaf to a degree not possible with us; we are rarely blessed with an Indian summer in the fall. The mineral matters flowing to the dying leaf flow in a quantity directly proportionate to the decay of its vitality. There is a drainage of substances (especially of silica) from the living portions of the arboreal organism to the dead and dying parts thereof. In such of our leaves as can resist the rigorous climatic severity, their vitality is so far sustained that the normal process of de-assimilation (the development of coloured pigment from tannic chromogen) is not impeded, though never so complete and splendid as in the glorious forests of New England.

Patterdale, Westmorland. P. Q. KEEGAN.

Variation of Atmospheric Absorption.

WITH regard to Prof. Langley's letter on the abnormal atmospheric absorption (p. 5) some observations of a different nature may be of interest.

Both this year and last I was photographing in Switzerland, using a Wynne meter for timing my exposures. In 1902 I found that the time required to darken the sensitive paper on a sunny day, at an elevation of 11,000 feet, was one second. This year the time, under exactly similar conditions, and using the same batch of paper, was three seconds. That the difference was not due to the paper being stale is shown by the negatives being equally good in the two cases.

The maximum sensitiveness of the paper is for blue light; yellow and orange do not affect it; it was exposed under a glass plate about 3 mm. thick. J. TALBOT.

Harrow-on-the-Hill, November 7.

Rocket Lightning.

MR. J. EWEN DAVIDSON (98 Banbury Road, Oxford) has directed my attention to his letter in NATURE, vol. xlvii. p. 582, describing auroral appearances associated with a thunderstorm witnessed by him in Queensland, of which he was reminded by the letters headed "Rocket Lightning" in your issue of October 22, p. 599. Comparison of the two accounts is interesting, but the phenomena appear to me not to have been identical. Mr. Davidson says what struck him most in the recent account was the description of a misty cloud above the low bank of thick cloud. In his own case there was a very thin misty condensation over the thunderstorm, extending to an altitude of 40° or 45°, and "the rosy light phenomenon and the streamers only shot up to the upper edge of this misty condensation." He says, "I did not mention the misty condensation in my letter to NATURE, as I did not then connect the two, but thought it was a mere coincidence, the one slightly veiling the other; but that there is a connection is now evident." "Both observers were practically looking upon the upper edge of a thunderstorm at a distance, and in both cases there was the misty appearance above it, with the comparatively slow upward moving light phenomena." J. D. EVERETT.

11 Leopold Road, Ealing, W., October 29.

Explosive Action of Lightning.

THE following particulars of the circumstances attending a lightning flash are perhaps worth recording.

A cedar tree (deodar) 50 feet high stood at a distance considerably less than its own height from a house at Englefield Green. The lady of the house was sitting watching the storm, but in such a position that she could not see the cedar, but could see a large part of an Araucaria (the common "monkey puzzle") just outside her window, and only 30 or 40 feet from the cedar. While watching this tree the lady saw, as she thought, a "rod" or "stick" of fire come crashing down through its branches—beating them down so that she distinctly saw them rebound. This was accompanied by a fearful noise as of a thousand pistol cracks, beside which, however, the lady had an impression of hearing the branches of the Araucaria beating together, and immediately afterwards a cloud as of steam rose from the lawn on which the trees stood. It was found that the cedar tree had been wrecked entirely. About 15 feet of the top was broken off, and apparently fell straight down—sticking in the ground almost vertically—close to the stump of the tree. The main portion of the trunk, to about 4 feet from the ground, was roughly split in two—falling right and left—one half being further burst into several pieces. There was the usual "smell of sulphur," but no sign of scorching on either of the trees.

A gentleman who saw the flash from a distance of about one-third of a mile noted that it was a straight (non-forked) flash from a small cloud low down. Other observers noted flashes of a similar character during the same storm.

The cedar tree was in vigorous growth, full of sap, and well above its *immediate* surroundings, but there were elms and a lime tree of greater height within fifty yards of it.

The movement and the "fire" in the branches of the Araucaria seem to me to suggest an electrostatic effect—a side splash—rather than the mere reflection of the flash which struck the cedar. Could the beating down of the branches be explained as the result of the sudden pulse in the air? What produced the cloud of "steam"? It would be interesting to have the opinion of an authority on lightning discharges with regard to these points.

R. A. WEST.

Ordnance College, Woolwich, October 27.

The "Sky-coloured" Clouds.

DURING this summer I have seen only one display of the "sky-coloured" clouds, or "night-shining clouds" as the late Herr O. Jesse used to call them. It was on July 8, and was a bright display, the brightest I have seen for some years. It is rather singular they did not appear on other occasions so far as I have observed, and no mention of them has been made in your periodical. It may be that now Herr Jesse is deceased there has not been such a good and systematic watch maintained as formerly, or else, if they have been observed abroad, notices have not been copied into English papers. Whether the brilliancy of this one display was connected with the eruptions in the West Indies is a matter of conjecture. The volcanic dust continues to be very visible in the sky in producing the great corona round the sun all day.

T. W. BACKHOUSE.

West Hendon House, Sunderland, October 28.

THE GEOLOGY OF VANUA LEVU.[1]

VANUA LEVU, one of the two principal islands in the Fiji archipelago, according to Mr. Guppy's summary of previous investigations, has received less notice than Viti Levu, or even some of the smaller islands. The late Prof. Dana made a small collection of its rocks in 1840, and published some observations on its geology. It was visited in 1878 by Mr. J. Horne, of Mauritius, but no collections were made by him, by the *Challenger*, or by investigators under the direction of Prof. A. Agassiz, so that it offered a very promising field of research, which occupied Mr. Guppy for two years. The results, so far as concerns its geological and general physical features, and the petrology of its rocks, are described in the present volume, with reproduced photographs and other illustrations.

The long irregular outline of Vanua Levu contrasts strongly with the comparatively rounded one of Viti Levu. Its length is about 98 miles, with a breadth averaging 15 to 20 miles, its estimated area being about 2400 square miles, nearly equal to that of the county of Devon, while its maximum elevation is almost 3500 feet. Both this island and Viti Levu rise from a submarine plateau, in shape a broad irregular ring, broken in one place. An elevation of less than 100 fathoms would convert the whole area into one great mountainous island, pierced on the southern side by a fjord more than 200 fathoms deep. This platform Mr. Guppy considers to have been built up from the deeper ocean floor by submarine lava flows and associated deposits, and Vanua Levu as a composite island, formed, during a long period of emergence, by the union of a number of large and small islands, the products of submarine eruptions. The process probably began in the later Tertiary period, and volcanic eruptions have now ceased, but hot springs are not uncommon, though limited to regions where basic rocks occur. They are also restricted in vertical range, for they have not been found above the 300 feet contour line. Their temperature mostly ranges from 100° to 150° F., reaching 180° only in one case, the latter group precipitating siliceous sinter. Mr. Guppy thinks these springs are largely supplied by the "soakage" of the heavy rainfall in the mountains; if so, there must be rapid local rises in the underground temperature. A submergence of 300 feet would bring the sea over a considerable tract, chiefly basaltic plains, which are obviously continuous with the submarine plateau. One of 1000 feet would greatly reduce and indent the remaining axis of the island, while 800 feet more would convert it into a few scattered islets, which would represent the nuclei of the present composite Vanua Levu. This mode of building accounts for the irregularities of its physical structure, in which respect it contrasts markedly with the other large island, Viti Levu.

Proof of this great elevation is found in the occurrence of muds and tuffs with marine organisms up to at least 2000 feet above sea-level. Shelly and foraminiferal limestones, composed, as so often in tropical islands, partly of reef débris, partly of more or less broken shells of Mollusca, partly of Foraminifera, occur up to a height of 1100 feet, and they sometimes overlie palagonite tuffs and clays, also foraminiferal. Pteropod ooze, containing a large amount of palagonitic débris, is found up to about 500 feet, but volcanic muds, which are very abundant on the basaltic plains in association with the lava flows, reach the former elevation, while tuffs, sometimes agglomeratic, may be traced up beyond 2000 feet—all these containing Foraminifera. An instance of these deposits is shown in the illustration. Raised coral reefs are not very common, and appear to be limited to a vertical range of about 100 feet above sea-level, so that in this respect Vanua Levu contrasts strongly with Viti Levu. But Mr. Guppy thinks this scarcity to some extent the result of denudation, for he has found silicified corals, representing reef-forming types, lying about on the surface, abundantly in some places, together with nodules of chalcedony and other siliceous concretions. These, however, do not more than double the vertical range, so that during the actual building of the island circumstances were not favourable to reef-

[1] "Observations of a Naturalist in the Pacific between 1896 and 1899." By H. B. Guppy, M.B., F.R.S.E. Vol. i. Vanua Levu, Fiji. Pp. xix+392; illustrations and map. (London: Macmillan and Co., Ltd.; New York: The Macmillan Co., 1903.) Price 15s. net.

formation. It is possible, as Mr. Guppy explains, that the island even now is slowly rising.

A considerable part of the volume is devoted to the petrology of Vanua Levu. Plutonic rocks occur, though on a smaller scale than in Viti Levu. These are norites (hypersthene-gabbros) and a few diorites (without augite). The rest of the igneous rocks are volcanic, consisting of olivine-basalts, augite-andesites with and without hypersthene, and acid andesites passing into dacites, in which sometimes the ground-mass exhibits a felsitic structure. Mr. Guppy's careful study of these is a valuable addition to knowledge, though the volcanoes of Vanua Levu have not yielded any rock of exceptional interest. But we think he lays too much stress on varietal details, and that his "orders, suborders, genera and subgenera" have often no more than a specific value, and that he attaches too much classificatory importance to the presence or absence of phenocrysts (to follow him in using this modern petrological slang-word). They have an important relation to the history of the rock, but not very much to its chemical composition, and thus to its position among the magmatic products of the earth. A porphyritic rock is a "rock with a past," which a non-porphyritic rock either is free from, or successfully conceals. Mr. Guppy has "gone one better" than most modern terminologists. Throughout his descriptions he talks of felspar-lathes, meaning thereby the microliths, generally called lath-like. In English a lath means a long blade-like strip of wood, used, for instance, in ceilings, and not inaptly designating microliths of felspar, especially plagioclastic, while a lathe is a machine for turning wood, &c. We doubt also whether the formulæ which Mr. Guppy employs to summarise the characters of his rocks will be any real help to the memory, for they introduce the perplexities of gibberish without attaining the simplicity of mathematical symbols. Palagonite is very abundant at Vanua Levu, "from the sea border to the mountain top." Mr. Guppy discusses at some length the origin of this substance, coming to the conclusion that it is usually associated with basalt of an ophitic or semi-ophitic habit, is likely to be formed extensively on the surface of submarine basaltic flows, and is a vitreous condition of magma that remains fluid after the mass of the rock has solidified. An exceptionally hydrous state of a basic magma would probably be very favourable to the formation of palagonite, but whether the proposed petrological relation will hold generally good is perhaps doubtful.

But in expressing dissent on a few points, which are really of minor importance, we gratefully acknowledge that Mr. Guppy has accomplished a very laborious and often difficult, if not dangerous, task, and that his book, when completed by accounts of his botanical and other work, will be a most valuable addition to our knowledge of this group of islands and to the past geological history of a large area in the Pacific Ocean.

T. G. BONNEY.

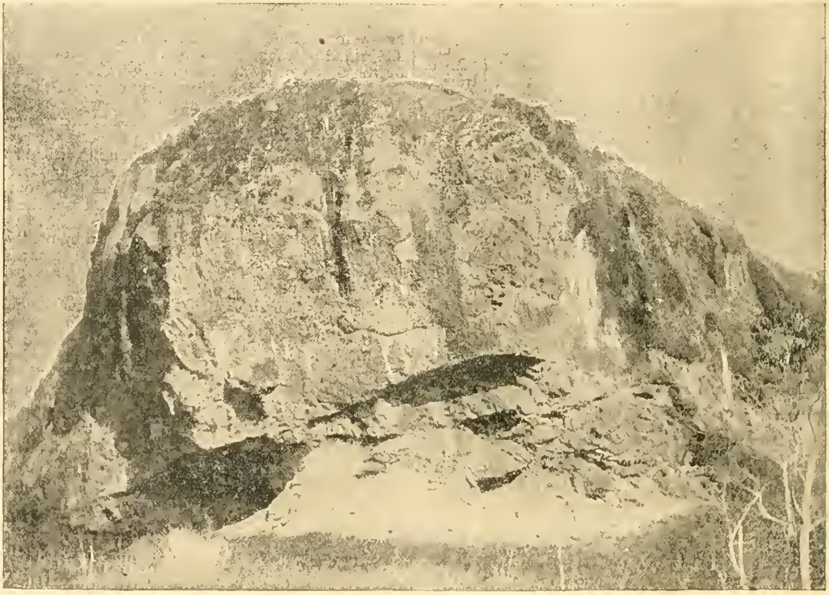

FIG. 1.—Mbenutha. Agglomerates on tuffs, &c., containing Foraminifera and Pteropods, now 1100 feet above sea-level.

ELECTRIC CONVECTION.[1]

THIS paper closes in a satisfactory manner an important controversy. It follows from the views of Faraday and Maxwell that a charge of electricity when in motion produces a magnetic field in its neighbourhood. It is this effect on which the modern

[1] "Recherches Contradictoires sur l'Effet magnétique de la Convection électrique." Par MM. Harold Pender et Victor Crémieu. (*Journal de Physique*, September, 1903.)

electron theory of electric action rests; its experimental verification is vital to the theory, and, indeed, to the whole of the recent views, of the origin of electric and magnetic forces.

A method of testing the existence of the effect is given by Maxwell in his "Electricity and Magnetism," and was first put into practice, with some modifications, by Rowland in 1876. The experiment, carried out in Helmholtz's laboratory, proved to the satisfaction of Helmholtz and of Maxwell that the effect existed; this consisted in rotating a charged disc of gilded ebonite near an astatic magnetic needle and observing the deflection. This was very small, from 5 to 7·5 mm., but it agreed with the amount expected from the theory. In 1883 Lecher attempted to repeat these experiments, but with negative results; Röntgen, however, in a research having another object, obtained the same effect from a moving charge as Rowland had done. In 1889 Rowland and Hutchinson took the matter up, and, modifying the apparatus, obtained results which appeared to establish the convection of an electric charge on a moving conductor without a doubt.

In 1897 Crémieu began his experiments. If a charged moving conductor produces a magnetic field, a charged conductor at rest in a varying magnetic field should be subject to mechanical force. Crémieu failed to detect this force in an experiment arranged for its measurement, though, according to calculation, it ought, if existing, to have been easily measurable. He then attempted Rowland's reverse experiment, the detection of the magnetic field, but modified entirely and in an ingenious manner Rowland's arrangement. Imagine a coil placed in close proximity to the rotating disc, the planes of the two being parallel, and let the ends of the coil be connected to a galvanometer. On charging the disc a magnetic field is produced near the coil, if the Faraday-Maxwell views be true; thus a current is induced in the coil, and a throw of the needle of the galvanometer is the result. Then by arranging to charge and discharge the disc alternately, and by means of a commutator to reverse the galvanometer connections suitably, the throw becomes a permanent deflection the amount of which can be calculated. These experiments Crémieu carried out with consummate care, and the result was negative. The needle remained at rest; there was no such thing as electrical convection. This fact he verified apparently by several ingenious modifications of his apparatus and his method, always with the same result; and when at the Glasgow meeting of the British Association he gave an account of his work, probably no one in the room except himself accepted his results, but no one, and the critics were both acute and numerous, could find the flaw.

Meanwhile, Rowland had returned to the defence of his position; it was almost the last piece of work he undertook, and just at the time of Crémieu's visit to Glasgow, September, 1901, there appeared a full account of experiments in the Johns Hopkins Laboratory by Pender, who, adopting Crémieu's induction method, again verified Rowland's result. From the observations a value can be found for the velocity of light, and Pender found it to be $3·05 \times 10^{10}$ cm. per second, a value sufficiently near to the truth to establish beyond a doubt the theory of the measurements. This was verified by further work published early this year; meanwhile, Crémieu continued to obtain his negative results.

Such was the position when Pender was invited to Paris to repeat, in the splendid laboratories of the Sorbonne, and in conjunction with Crémieu, the experiments he had made in Baltimore. Funds were provided, in part by the Carnegie Institution, in part by the Institute of France, and the two experimenters set to work together, and with the same result—Pender verified the Faraday-Maxwell theory, Crémieu disproved it.

Experiments were then made on the direct magnetic effect, repeating, but with some modifications to meet objections of Crémieu, Rowland's original experiment. These, again, led to the result that a charged surface moving in its own plane produces a magnetic field; the very sensitive and permanent astatic system employed in this experiment will be found useful elsewhere, but reference must be made to the original paper for an account of it. Finally, Crémieu was convinced; it remained only to account for his negative results.

It was observed that in all cases he had covered the charged conducting surfaces with a thin layer of some dielectric other than air, usually india-rubber or mica, and there seemed some reason to suppose his failure was due to this, and so it was proved to be; the removal of the dielectric coating from Crémieu's apparatus enabled him to observe the convection effect, while by coating the discs used in Pender's induction experiment with mica, the convection effect was reduced by some 90 per cent.

How the dielectric acts is still a mystery; it is satisfactory, however, that the two experimenters are in agreement. The thanks of physicists are due to those who suggested and rendered possible this somewhat novel collaboration; it is satisfactory to the great French physicists who have aided Crémieu with advice and assistance that the matter should be settled at Paris; it is satisfactory to Pender that he has established conclusively and finally the result which was the beginning of Rowland's brilliant fame.

At the same time, the question, What does the dielectric do? remains an interesting one, especially as Vasilesco-Karpen, in a paper which follows the one we have been discussing, finds that it has no effect on the result. He modified Crémieu's arrangement by introducing a condenser into his circuit of coil, commutator and galvanometer, in which induced currents are set up by the alternating charge and discharge of the rotating discs. By suitably arranging the period of this circuit he was able to intensify the efforts considerably, and obtained a reasonably satisfactory agreement between his results and theory. The disc, as was the case in most of Pender and Crémieu's experiments, moved between condensing plates, and Vasilesco-Karpen made the following four series of experiments:—(1) Disc bare, condensing plates bare; (2) disc bare, condensing plates covered with glass 4 mm. in thickness; (3) disc covered with a thin layer of caoutchouc, condensing plates bare; (4) disc as in (3), condensing plates as in (2).

He states as the result that, so long as the speed and the charging voltage are kept constant, the magnetic effect is the same in all these cases. This result is opposed to that of Crémieu and Pender, who found that coating the disc with a thin layer of rubber destroyed the convection effect, and so the matter rests at present. The magnetic effect due to the motion of an electron is confirmed; some of its secondary consequences remain obscure.

NOTES.

The list of birthday honours includes the following names of men known in the scientific world:—Prof. C. Le Neve Foster, F.R.S., has received the honour of knighthood. Colonel D. A. Johnston, director-general of the Ordnance Survey, has been appointed a Companion of the Order of the Bath. Dr. Robert Bell, F.R.S., acting director of the Geological Survey of Canada, has been appointed a Companion of the Imperial Service Order. The

Hon. A. C. Gregory, formerly surveyor-general of Queensland, who has done much for exploration and the promotion of science in Australia, has been promoted to the rank of K.C.M.G.

The following is a list of those to whom the Royal Society has this year awarded medals. The awards of the Royal medals have received His Majesty the King's approval:—The Copley medal to Prof. Eduard Suess for his eminent geological services, and especially for the original researches and conclusions published in his great work "Das Antlitz der Erde"; a Royal medal to Mr. Horace T. Brown for his work on the chemistry of the carbohydrates, and on the assimilation of carbonic acid by green plants; a Royal medal to Sir David Gill for his researches in solar and stellar parallax, and his energetic direction of the Royal Observatory at the Cape of Good Hope; the Davy medal to M. Pierre Curie and Madame Curie for their researches on radium; the Hughes medal to Prof. J. Wilhelm Hittorf for his experimental researches on the electric discharge in liquids and gases.

We are informed that Dr. Charles J. Martin, F.R.S., has now entered upon his duties as director of the Lister Institute of Preventive Medicine, and in future the administrative work of the Institute will be under his control.

The annual course of Christmas lectures at the Royal Institution, specially adapted to young people, will be delivered by Prof. Ray Lankester, F.R.S., whose subject is "Extinct Animals." The first lecture will be given on Tuesday, December 29.

An application has been made by the German Meteorological Office for daily telegraphic reports from the Ben Nevis Observatory, with the view of applying them in forecasting the weather of north-western Europe. The directors of the observatory have agreed to send the telegrams asked for.

Many biologists will regret to know that Mr. I. C. Thompson, well known as a naturalist, and especially for his work in connection with the Liverpool Marine Biology Committee, died suddenly on November 6.

Prof. Raphael Pumpelly, of Newport, R.I., and Prof. W. M. Davis, of Harvard, have returned from a journey in Turkestan, made under the auspices of the Carnegie Institution, to study the ancient human occupation of the region in relation to its physiography. *Science* states that the expedition proceeded from Baku to the end of the main line of the Central Asiatic Railway at Tashkent. Prof. Pumpelly, with one party, then made an excursion south-eastward across the Alai range and valley to Lake Karakul on the northern Pamir. Prof. Davis and his party went north-east, crossing the western Tian Shan ranges to Lake Issikul.

It is reported in some of the daily papers that Dr. Otto Schmidt, of Cologne, has succeeded in isolating and cultivating a parasite from cancer, and in preparing an antiserum for the disease. So many positive statements of the isolation of a cancer-parasite have been made during the last few years, and have subsequently proved to be incorrect, and so many capable men have been investigating cancer without result, that reports of this kind cannot be accepted without further proof. The publicity given to matters of this kind is much to be deprecated; in the majority of instances false hopes are raised which must end in disappointment for many sufferers.

Lieut.-Colonel Bruce, who has been investigating sleeping sickness in Uganda, has returned to England, having confirmed and extended the observations of Castellani upon the presence of a trypanosome parasite in this disease. The trypanosome was found to be present in practically every case in the cerebro-spinal fluid, and also in the blood. From analogy with nagana or tsetse fly disease of horses and cattle, it was surmised that a species of tsetse fly might carry the infection in sleeping sickness, and along the shores of the Lake Victoria Nyanza, where the disease is especially rife, large numbers of a tsetse fly (*Glossina palpalis*) were found, and were demonstrated by experiment to be capable of carrying the trypanosome. Moreover, freshly caught flies in infected areas were in some instances found to harbour trypanosomes. It is further suggestive that this fly is confined to certain well-defined areas which correspond absolutely with the distribution of sleeping sickness; in regions where no *Glossina palpalis* is found there is no sleeping sickness. These investigations therefore point to the conclusion that sleeping sickness is a human tsetse fly disease.

At the Royal Geographical Society on Tuesday Commander Peary gave an address on his "Four Years' Arctic Exploration, 1898–1902." In the year 1899 he obtained the material for an authentic map of the Buchanan Bay, Bache Peninsula, Princess Marie Bay region, crossed the Ellesmere Land ice-cap to the west side of that land, established a continuous line of caches from Cape Sabine to Fort Conger, and familiarised himself and party with the entire region as far north as Cape Beechey. During the journey in 1900 Commander Peary determined conclusively the northern limit of the Greenland archipelago, or land group, and practically connected the coast south-eastward to Independence Bay, leaving only that comparatively short portion of the periphery of Greenland lying between Independence Bay and Cape Bismarck indeterminate. The non-existence of land for a very considerable distance to the northward and north-eastward was also settled, with every indication pointing to the belief that the coast along which the party travelled formed the shore of an uninterrupted central polar sea extending to the Pole, and beyond to the Spitsbergen and Franz Josef Land groups of the opposite hemisphere. In 1901 Commander Peary left Conger for another northern trip, but on reaching Lincoln Bay it was evident that the condition of men and dogs negatived the possibility of reaching the Pole, so the party returned to the *Windward* at Payer Harbour. In 1902 a start was made from Payer Harbour for the northern journey, and latitude 84° 17′ 27″ N. was reached, but the party had to return, and in the autumn of the year the *Windward* steamed southward, arriving at Sydney, C.B., on September 17, 1902, after an absence of four years, three months, and ten days. Referring to his future plans, Commander Peary said he hoped to start north next July, and if the season was favourable he would have his ship by September 1 on the northern shore of Grant Land, near the *Alert's* winter quarters. Wintering there, he would start with the first of returning daylight in the following February to make a journey across the polar pack to the Pole and back again.

Major Ronald Ross read a paper on malaria in India and the colonies at the Royal Colonial Institute on Tuesday. In the course of his address he pointed out that scientific research has established three great laws concerning malaria:—first, that it is caused by numbers of microscopical parasites which live and propagate themselves in the blood; secondly, that these parasites are carried from sick persons to healthy ones by the agency of a genus of

mosquitoes called Anopheles; thirdly, that these kinds of mosquitoes breed principally in shallow and stagnant terrestrial waters. Four years have elapsed since these facts were established, and a vast mass of information has been accumulated regarding the actual working of the preventive measures which have been based upon them. Major Ross described the State measures for the repression of malaria that have already led to successful results in Sierra Leone, Havana, Lagos, Ismailia, the German colonies, Hong Kong, and other places. It has been proposed that permanent sanitary commissioners should be appointed for some of the colonies, but Major Ross said that Mr. Chamberlain has suggested to him an alternative scheme, namely, that several learned societies should periodically be asked to send out special commissioners for the purpose of examining and reporting upon the sanitary affairs of specified tropical Crown colonies, and that such reports, after editing by the societies referred to, might then be submitted to Government for consideration. Commissioners of this kind would cost less, and, not being servants of Government, would be able to give entirely unprejudiced opinions.

A DEMONSTRATION was given last week at the works of Messrs. Johnson and Phillips of a new electrical process for the preparation of peat-fuel. The process aims at extracting the large percentage of water in peat, partly by mechanical and partly by electrical means; the freshly cut peat is packed into rotating cylinders, and whilst fans beat out part of the moisture, a strong current of electricity is passed through the mass which heats it and thereby helps the extraction of the water. It is claimed that a first-class fuel can be produced in this way, but no particulars as to the cost of production, or results of tests of the fuel by competent engineers, are given in the pamphlet describing the invention.

THE Nagri Sabha established in Benares has, we learn from the *Pioneer Mail*, interested itself in making additions to the Hindi literature, but the difficulty of translating English scientific works, on account of the absence of suitable Hindi equivalents for the English technical terms, has been an obstacle in the way of authors. The Sabha, therefore, resolved to remove this difficulty by compiling, with expert aid an authoritative dictionary of scientific words and phrases met with in the English scientific works, and separate glossaries were ready last year and circulated for criticism among men of science in India. In order finally to approve and pass the tentative lists, the Sabha appointed a committee from among its members, and invited the various local Indian Governments to nominate representatives. Criticisms have been received from men of science in various parts of India.

THE medical officer of health for the City of London states in his last report that a case of enteric fever has been notified from Paddington as having in all probability been caused by mussels sold in Billingsgate Market. The mussels were found to have been obtained from a dealer at Leigh-on-Sea, and in consequence samples of mussels and cockles from the same source were submitted to Dr. Klein for bacteriological examination. Dr. Klein reported that both the cockles and the mussels were polluted with sewage, some of them to a dangerous extent, and that the cooking of the molluscs had been very imperfectly carried out. This state of affairs having been brought to the notice of the Fishmongers' Company, the sale of cockles from Leigh has been prohibited in the London markets. Some months ago the Leigh cockles were found to be polluted, and warnings were issued and directions given for a minimum period of boiling to be adopted, which seem to have been disregarded.

A VERY interesting lecture, entitled "Allerlei Methoden, das Wetter zu prophezeien," delivered by Prof. J. M. Pernter, director of the Austrian Weather Service, before the Society for the Diffusion of Scientific Knowledge, Vienna, has recently been published by that Society. As the title suggests, the author deals with all kinds of methods employed for weather prediction from the earliest to the present time. After doing full justice to the usefulness of local weather signs, such as the appearance and movements of clouds, the formation of caps on hills, the colour of morning and evening skies and the like, often successfully interpreted by agriculturists and others, he gives particular attention to *a priori* theories based on cycles, the phases of the moon, and the motions of planets, and points out their general untrustworthiness, and the great difference between such theories and the empirical inductive methods adopted by the meteorological central offices. By these latter means only can any advance be made. With the knowledge which at present exists, however, he holds out little hope of being able to forecast the weather for more than one day in advance. To improve upon the results now obtained, the author points out that a more minute investigation is required (1) of each point of every form of distribution of barometric pressure; (2) of the rate and direction of travel of each depression over Europe; (3) of the manner in which a certain type merges into another form; and (4) of the change in the weather caused by the various modifications of each form of barometric distribution. By a careful study of such details the author thinks that the percentage of total successes of the forecasts may be gradually raised.

IN the *Proceedings* of the American Academy of Arts and Sciences, Prof. R. W. Wood discusses the anomalous dispersion, absorption, and surface colour of nitroso-dimethylaniline. This substance is interesting as filling the gap that exists between the aniline dyes and ordinary transparent substances.

M. CH. FÉRY describes in the *Journal de Physique* a convenient method for determining the constants of lenses. It depends on the principle that if a ray falls on a lens in a direction parallel to the axis, and at a distance d from it, it will undergo an angular displacement α, the tangent of which is d/f, where f is the focal length, and by observing α, f can be found. Moreover, by calculating the values of f corresponding to different values of d, the aberration can be calculated.

MANY attempts have been made to give purely dynamical proofs both of Maxwell's law and of the second law of thermodynamics, but nearly every one of these deductions has, on closer examination, been found to involve some assumption or other, and not to be a result of mathematical reasoning alone. In two recent communications to the *Philosophical Magazine* (August and October) Mr. S. H. Burbury discusses the late Prof. Willard Gibbs's treatise on statistical mechanics and Mr. J. H. Jeans's theory of gases, and his criticisms go to show that these investigations form no exceptions to the rule.

THE *Scientific American* for October 10 contains two papers of interest in connection with the problem of "aviation." M. Émile Guarini describes some experiments by Prof. Bertelli for studying the action of air currents on curved surfaces such as may be taken to represent birds' wings, and a new aëroplane machine, con-

structed by Messrs. Groombridge and South, is described, which is stated to be 80 feet long and 60 feet wide (the figure of the "full-sized model" hardly corresponds to these dimensions), and is to be supported on two sets of superposed aëroplanes, one at the front and the other at the rear of the machine.

IN his fifth report on seismological investigations presented to the British Association at Bradford, Prof. Milne directed attention to the connection between large earthquakes and variations of latitude indicated by a comparison of the statistics for the period 1895–1898. Mr. Adolfo Cancani has published in the *Bolletino* of the Italian Seismological Society the corresponding figures for 1899–1902, and the results tend to confirm Prof. Milne's hypothesis. The figures for 1895 and 1896 give a smaller number of earthquakes satisfying the conditions laid down by Mr. Cancani than would be required on the hypothesis of such a connection, but this the author attributes to the fact that the arrangements organised by Prof. Milne for recording seismological observations were not completed in the two years in question.

WE have received from the makers—Messrs. Newton and Co., 3 Fleet Street—an extremely simple device called the "Boyla" tube, which has been designed for the purpose of demonstrating all the phenomena attendant upon the processes of ebullition and condensation. It consists of a strong glass tube about four inches long and three-eighths of an inch in diameter, in which a readily vaporisable liquid is hermetically sealed. When held over a very small flame the liquid boils, and when its temperature reaches the critical point the surface rises and becomes ill-defined; then the liquid vaporises and forms clouds in the upper portion of the tube, which in turn condense and form drops that fall through the space above the liquid in the form of rain. Thus the whole process of ebullition and condensation may be shown to a number of students at one time, and in a much more convenient manner than is at present in general use. The tube is bent round at the top in the form of a hook, so that it may be readily suspended over the flame, and, in the absence of accidents, it may be used over and over again *ad libitum*.

THE author of the article on "Botany at the British Association" in NATURE for November 5 writes to say that the last line of the paragraph dealing with Miss Sargant's paper on the origin of the Monocotyledons (p. 18) should read, "it was more like a Dicotyledon than a Monocotyledon." In his report he inadvertently transposed the words Dicotyledon and Monocotyledon.

THE September issue of the *American Naturalist* contains a continuation of Prof. Morse's synopses of North American invertebrates, this section dealing with the parasites of the genus Trichodectes, which infest mammals.

IN the October number of the *Zoologist* Mr. J. L. Bonhote records the existence of a British example of the mouse-coloured bat (*Myotis murinus*), taken at Girton in 1888. The specimen was probably brought over from the Continent with plants or other produce. The only other record of the species in our islands is afforded by some specimens taken in the grounds of the British Museum previous to 1855.

A PAPER in the October issue of the Zoological Society's *Proceedings* on "The Marine Fauna of Zanzibar and British East Africa," by Mr. F. F. Laidlaw, deals with the planarians of the Zanzibar district, in which, out of a total of nine species collected, eight are described as new, four of them being referred to new genera. Apparently no shore-haunting species have hitherto been recorded from the eastern side of Africa, except in the Red Sea and Cape Colony, hence the high percentage of novelties.

UNDER the title of "Cold Spring Harbor Monographs," the Brooklyn Institute has commenced the issue of a series of short animal biographies after the plan of the well-known "L.M.B.C. Memoirs." Of the two issues before us (forming the first and second of the series), the one, by Miss Smallwood, deals with the beach-flea or sand-hopper (*Talorchestia longicornis*), while the second, by Mr. Davenport, is devoted to the local representatives of the insects of the group Collembola, with special reference to the movements of the section included in the family Poduridæ. Both memoirs are illustrated with plates, which are perhaps a little rough in execution.

DR. O. ABEL, in the *Sitzungsberichte* of the Royal Vienna Academy, describes certain isolated molars of anthropoids from the Leithakalk. One of these, for which the name *Griphopithecus suessi* is suggested, indicates a new generic type, while the other is assigned to Dryopithecus, with the title *D. darwini*. It is also pointed out that the name *Arthropodus*, proposed by Dr. Schlosser last year for certain anthropoid remains, is preoccupied, and the name *Neopithecus* is suggested in its place. In the same journal Dr. F. Werner describes the reptilian and amphibian fauna of Asia Minor. Special attention is devoted to the true lizards (Lacerta), which are illustrated in three coloured plates, one form being described as new, under the name of *L. anatolica*.

A RECENT *Bulletin* of the New York State Museum is devoted to an account, by Dr. J. L. Kellogg, of the feeding habits and growth of *Venus mercenaria*, commonly known as the "little-neck clam." In his introductory remarks the author directs attention to the rapid diminution in the number both of that species and of the true "clam" (*Mya arenaria*), both of which form important articles of diet in New York. "Clam-farming" would undoubtedly long ago have taken the place of "clam-digging" were it not that beaches and sand-flats are public property to which everyone has the right of access. The little-neck clam, although it will also flourish between tide-marks, grows most abundantly below low-tide mark, where it is taken with tongs. "Much of the shallow bottom about Long Island, in which clams were formerly taken, has been leased to oystermen. The profit from oyster culture is much greater, acre for acre, than that derived from the taking of hard clams, which are left to propagate by the natural method. The areas left to clammers are now limited, and the great part of the supply used in the canning industry comes from the southern coast. At the same time clams are rapidly diminishing in the available beds."

THE new cone of Mont Pelée and the gorge of the Rivière Blanche, Martinique, are dealt with by Mr. E. O. Hovey (*Amer. Journ. Science*, October). He directs special attention to the new "spine" or obelisk of which an illustration was given in NATURE for October 1. Mr. Hovey remarks that no one can say exactly what the nature of the spine is, but probably it is largely pumiceous. Another striking feature is the filling of the gorge of the Rivière Blanche with calcined rocks, dust, and ashes which have been poured out of the crater by numerous eruptions.

THE National Transcontinental Railway is planned to extend to the north of the Canadian Pacific Railway, from New Brunswick through Quebec and Ontario to Winnipeg, in Manitoba. There it meets the Canadian Pacific Railway, and diverges again to the north, through parts of

Assiniboia, Saskatchewan, Alberta, and Athabasca, and across British Columbia to the neighbourhood of Port Simpson. In aid of this enterprise a concise report on the resources of the line of country between Quebec and Winnipeg has been drawn up by Dr. H. M. Ami, of the Geological Survey of Canada (Sessional Paper, No. 143). The physical geography, geology, soils and economic minerals, and the natural history generally are described.

In some notes on the geology of the Hawaiian Islands (*Amer. Journ. Science*, October), Mr. J. C. Branner directs attention to the striking series of canyons in the volcanic rocks on the northern coast of Hawaii. There are bluffs with an elevation of a thousand feet, and enormous gorges that extend inland with almost perpendicular walls, some of which are said to be 2000 feet in height. The gorges are nearly or quite as deep near their upper ends as at the lower ends, and they have flat bottoms. They were formed as V-shaped gorges on the land, and have sunk until their lower ends were occupied by the sea, forming deep fjords which were soon filled by material derived partly from the sea and partly from streams. Other interesting features are dealt with by Mr. Branner.

A full account of the life and work of the late Prof. Cornu is contained in the *Revue générale des Sciences* for October 30. The appreciation is from the pen of M. C. Raveau.

The lecture on the periodic system of the elements delivered by Sir William Ramsay at the recent meeting of the German Association at Cassel (see Nature, October 15, p. 586) has been published in pamphlet form by the firm of J. A. Barth, Leipzig.

Among articles dealing with scientific subjects contained in the November reviews and magazines, we notice two dealing with recent experiments on radium. One is by Mr. J. B. Burke on the radio-activity of matter, and is contained in the *Monthly Review*, the other, on the riddle of radium, is by Mr. A. S. M. Hutchinson, and is published in *Pearson's Magazine*. The latter magazine gives considerable prominence to science this month, for in addition to the article mentioned, there is one on "Our Descent from Monkeys," by Mr. S. S. Buckman, illustrated by photographs showing habits and characteristics that link man to monkey forms, and also descriptive accounts of the Waimangu geyser, New Zealand, and the habits of woodcocks.

A paper read by Mr. Edmund McClure at the Church Congress held at Bristol last month is a satisfactory indication of the sympathetic attitude which the churches now show towards scientific research. Mr. McClure's paper was entitled "The Aids which Science gives to the Religious Mind," and in it, after referring to Mendeléeff's periodic law and the recent work of Sir W. Crookes and Sir W. Ramsay, he asks:—"Does not the religious mind, which lives and moves in the sphere of the unseen, find an aid in such an extension of the reach of the mental eye?" It is encouraging to know that scientific work and thought can inspire reflections on the relation between the visible and invisible universes.

Messrs. Townson and Mercer, of Camomile Street, London, have submitted to us for examination a form of extensimeter designed by the Rev. G. B. Lavelle, of Waterford. The method of measuring linear expansion upon which the construction of the apparatus depends, is already well known in physical laboratories, and the apparatus is an elaborate form of one described in elementary books on practical physics. The instrument consists of a brass cylinder half a metre long, with side tubes for the ingress and egress of steam. The half-metre metal rod of which the linear expansion is to be determined rests on the bottom of the cylinder, and its other end passes through a hole in a movable metal cap to the cylinder. Temperatures are measured by thermometers introduced through india-rubber stoppers in the side tubes, and the spherometer is supported on a brass plate with a hole in the centre, the plate being so supported that it and the spherometer can be moved away from any issuing steam. A dry cell and electric bell are supplied with the apparatus to provide for greater accuracy in determining the instant of contact between the spherometer and the metal rod, but this seems an unnecessary elaboration.

High vacua for distillation under reduced pressure can be rapidly produced by filling the apparatus with carbon dioxide and condensing this with liquid air. Liquid carbon dioxide cannot be used, as it contains 0·75 per cent. by volume of dissolved air, but carbon dioxide snow gave good results; the dissolved air, like that dissolved in water, contains an excess of oxygen, the proportion being 24·1 per cent. by volume. The most convenient method is to prepare the gas from marble and hydrochloric acid, and to exhaust to 30 mm. by means of a water-pump; this operation is repeated four times, and on cooling with liquid air a vacuum of 0·1 mm. is produced. The lowest pressure recorded was 0·026 mm. when rubber connections were used, but in a vessel made wholly of glass the vacuum required for the production of kathode rays could be obtained. Ernst Erdmann, in describing this method in a recent number of the *Berichte*, adds that in London liquid air costs less than fivepence per kilo.

The additions to the Zoological Society's Gardens during the past week include a Ring-tailed Lemur (*Lemur catta*) from Madagascar, presented by Lady Campbell; a Grey Seal (*Halichoerus grypus*) from the West Coast of Ireland, two Meyer's Parrots (*Poeocephalus meyeri*) from South-east Africa, two Yellow-billed Cardinals (*Paroaria capitata*) from Chili, five Bungoma River Turtle (*Emyda granosa*), three Roofed Tortoises (*Kachuga tectum*), three Indian Eryx (*Eryx johni*), four Conical Eryx (*Eryx conicus*) from India, a Four-lined Snake (*Coluber quatuorlineatus*), South European, deposited; a Polar Bear (*Ursus maritimus*) from Nova Zembla, purchased.

OUR ASTRONOMICAL COLUMN.

Revision of Rowland's Wave-lengths.—In view of the extreme importance to workers in astrophysics of having a perfectly trustworthy system of standard wave-lengths, Prof. Hartmann reviews, in No. 3, vol. xviii., of the *Astrophysical Journal*, the methods used by Rowland in constructing his wave-length tables, and points out their sources of error. He shows that Rowland made the metallic arc wave-lengths given in his "New Table of Standard Wave-lengths" coincide with those of the solar spectrum by applying purely empirical corrections which cannot now be found. In a series of tables Prof. Hartmann also shows that differences, amounting in some cases to 0·03 unit, exist between the solar and metallic wave-lengths, and suggests that further experiments should be performed, on similar lines to those pursued by Michelson and Fabry and Perot, for the purpose of determining a general factor—the F of Fabry and Perot—by which the whole of Rowland's table might be reduced to a rationalised standard from the equation $\lambda = (F \text{ and } P)Fo$, where (F and P) is the absolute wave-length found by the French observers, and Fo is the factor mentioned above. This would produce an errorless wave-length on Rowland's scale for each of the thirty-three lines measured by Fabry

and Perot, which would vary but little from Rowland's values, and yet be free from their systematic errors.

Prof. Hartmann has already done this for the part of the spectrum on which Fabry and Perot worked, and has obtained a correction, C, which, when applied to the values given in Rowland's "Preliminary Table," rids them of the errors discussed by him. Not having the necessary facilities for pursuing this important work himself, Prof. Hartmann appeals to those spectroscopists who have them to complete the work commenced by Michelson, Jewell, and Fabry and Perot for the whole of Rowland's tables.

PARALLAX OF β CASSIOPEIÆ.—In a note to No. 3910 of the *Astronomische Nachrichten*, Herr S. Kóstinksky, of Pulkowa, discusses the results of three separate determinations of the parallax of β Cassiopeiæ. The first of these was obtained by Prof. Pritchard, using the photographic method, at Oxford in 1888, and gave the value $\pi = +0''\cdot15 \pm 0''\cdot02$; the second, obtained by Herr Kóstinksky himself, using the transit instrument in the prime vertical, gave a mean value of $\pi = +0''\cdot14 \pm 0''\cdot03$, whilst the third was recently obtained by Mr. A. S. Flint, of the Washburn Observatory, from meridian-passage observations, and produced as the mean result $\pi = +0''\cdot10 \pm 0''\cdot03$.

On considering these three values, obtained by three different methods, Herr Kóstinksky arrives at the conclusion that the absolute value of the parallax of β Cassiopeiæ is with great probability very near to $+0''\cdot1$, and rather a little greater than less.

ASTRONOMY IN SCHOOLS.—Mr. W. W. Payne contributes an interesting article to No. 108 (October) of *Popular Astronomy*, in which he strongly advocates the introduction of practical yet simple astronomical observations into the ordinary higher grade school's curriculum. He points out the absurdity of the general opinion that large instruments and expensive equipments are necessary in order to render observational astronomy a truly educative subject, and shows that a large amount of real training of the observational powers might be given with a small telescope. As examples of the type of observation he would suggest, he mentions the recognition of the brighter stars by name, and the keeping of methodical records of their light and colour characteristics and their occasional changes. Then, with quite a small telescope, a large amount of useful work—from an educative point of view—might be performed in observing and methodically recording the characteristics of some of the finer examples of multiple stars.

UNIVERSITIES: THEIR AIMS, DUTIES, AND IDEALS.[1]

VARIETY OF TYPES OF UNIVERSITIES.

ONE remark of a general kind must be made before proceeding to a synthesis of the purposes of universities. It is a platitude, yet not unimportant, to the effect that they will not be (and cannot be expected to be) uniform in character. Old universities have their traditions, sometimes the growth of centuries; and though they have to review their ideals from time to time and to revise their practice to meet the challenges and the demands made by the growing needs of the nation, changes are made only gradually, and the main character tends to persist through the changes. On the other hand, new universities arise in response to new demands of diverse kinds, and their character is bound to be shaped by their origin, their circumstances, and their growth. In the later Middle Ages, the philosophy of the schoolmen yielded before the onset of the study of the humanities—a study which has largely determined the character of our oldest universities. The physical sciences, by their growth during the last century, have modified the range of education and have influenced profoundly some of the older universities, while they have had no small share in dominating the form of newer foundations. The needs of applied sciences and practical sciences in our own day are stirring ideals of education widely removed from those that reposed upon the humanities, and they are leading to the establishment of learned institutions of types hitherto unknown. Sometimes between one university and another, sometimes within the limits of a single university, there will be what is almost a struggle among the subjects in their historical assignment to courses of study. Fundamental questions are being asked. Should the study of modern languages displace that of the ancient languages? Will applied science diminish the attention paid to pure science? Will practical needs direct the study of applied science? Must the acquisition of so-called useless knowledge be renounced in favour of so-called useful knowledge? Can it still be possible to maintain the process of a liberal education in the presence of the demands for technical instruction and commercial instruction? These and many other questions will arise in practically every university. They must be answered when they arise, and the answers will vary, perhaps from time to time, certainly from body to body. Yet diversity of character, of circumstances, and of practice, will not exclude a certain community of spirit and a certain similarity of obligation.

[1] Part of an address to the Southport Literary and Philosophical Society, delivered on September 17 by Prof. A. R. Forsyth, F.R.S.

WHAT IS A UNIVERSITY?

What is a university? Is it a building, or a set of buildings? Is it a federation of schools? Is it an aggregation of faculties? Is it a corporation of individuals, formally devoted to a common purpose? Is it an examining body with power to grant degrees? In each of these senses, and doubtless in several others, the word university has been vaguely used at different times and of different bodies. In its earliest use in regard to the kind of institution under consideration, a university appears to have been a sort of scholastic guild; there were societies of masters, as there were societies of students, and each of these was called a university. There were two places where these guilds grew into greater importance than elsewhere at the close of the twelfth century; one was Paris, mainly a university of masters, the other was Bologna, mainly a university of students. Indeed, so supremely important were these two universities, even while they were so distinctively different in character, that most of the older European universities have conformed to one or other of these types in many (if not in most) essential features. Thus Oxford and Cambridge are modelled on the master university of Paris; it is the graduates who have the power of electing the acting chief of the university. On the other hand, the ancient Scottish universities are modelled on the student university of Bologna; it is the undergraduates who have the power of electing the acting chief of the university. There have been variations in the detailed developments of the different universities. Most of them had several faculties, though not all of them had the same faculties. Thus Salerno, at the zenith of its fame towards the end of the eleventh century, was simply a medical school (having, it may be mentioned, several women among its teachers and writers). Bologna had a faculty of law only; Paris had faculties of theology and arts; Saragossa had one of arts only. The notion that a university was a school in which all branches of knowledge are represented was one that sprang up later, and had a considerable vogue; this Literary Society will readily recall Dr. Johnson's description of a university as "a school where everything may be learnt." The conception of a university as a centre for the cultivation of universal knowledge and the teaching of universal knowledge undoubtedly propounds a stimulating ideal, and the realisation of the ideal is as nearly imperative in modern times as anything almost impossible can be. At any rate, I know of no instance in which that conception of a university is justified by actual facts; and there is on record one instance in which the conception was completely falsified by actual facts, in that no teaching of any kind of knowledge whatever was done—the old university of London, now modified into a university that not merely examines, but also teaches.

CHARACTERISTICS.

What, then, should be taken as the working conception of an ideal university? To my mind, it is a corporation of teachers and students, banded together for the pursuit of learning and the increase of knowledge, duly housed, and fitly endowed to meet the demands raised in the achievement of its purposes. In the prosecution of its academic

aims, the university should be free from all external censorship of doctrine; it should also be free from all external control over the range, or the modes, or the subjects, of teaching. Above all, thought should be free from fetters of official type: whether political, from the State; or ecclesiastical, from the churches; or civic, from the community; or pedantic, from the corporate repressive action of the university itself. In its establishment, the amplest powers that wisdom can suggest should be conferred upon it. In working out its intellectual salvation, the exercise of those powers should be vested in select bodies of fit persons, sufficiently small in number to be efficient, yet large enough in number to prevent degeneration into an intellectual clique, changing sufficiently from time to time to prevent the dominance of merely personal policies, and representative enough to be in touch alike with the experience of the past and with aspirations for the future so far as these have taken shape or have acquired definition.

Access to the facilities of the university should be open to all duly qualified persons, without consideration of sex, without consideration of station in life, without consideration of intellectual beliefs, whether theological, political, or otherwise. The university should have the power of requiring both a minimum of qualification and a variety of qualifications to be satisfied by an applicant before admission to the status of student. Some test of qualification had to be imposed upon mediæval students, for Latin, then still something of a living language, was the one language of learning—and workers in science can sigh that it ever ceased to be so. That some test of qualification still is desirable probably is obvious to anyone who accepts my view of what university education should be. In my view, the school should prepare for the university, and education in the university should be, not something distinct from the school education, but rather its development, its amplification, and (on some issues) its complement. Briefly stated, the preliminary training should have been finished, and only those whose attainments show that they are qualified to profit by further training should be admitted to the courses of university study.

Qualification of Students.

As this limitation is important, will you be patient with me while I make a digression from my main topic and indicate the kind of minimum of qualification that I, if an autocrat, should exact in order to have one security (necessary, though not sufficient) that the students shall be not unworthy of a seat of learning? Besides the usual elements of reading, writing, and arithmetic (and I would add drawing to them), his studies should have included subjects that would train and develop some power of expression, some power of reasoning, some power of observation. To give him some power of expression, I would use his own language in the first place, initiating him into the mysteries of grammar and analysis through it alone, giving him some acquaintance with selections from the best of its literature, and, above all, practising him regularly in the art of composition in his own language. Then, after a certain stage, and in order to give him, while still at school, a more accurate literary training, he should be drilled in at least one foreign language, so as to be able to read it with ease and accuracy; the contrast of the two languages in idiom, diction, method, and manner, should emphasise his critical appreciation of his own, and increase, therefore, his control over it. If he can spare time for only one foreign language, my choice would be a modern language; if he can spare time for two foreign languages, let Latin be one of them; if he can spare time for more, he is in the way of being a scholar, and he needs none of my presumptuous directions on this head. To give him some power of reasoning, I would use the elements of mathematics; his algebra should be built upon his arithmetic, without the fatuous artificialities that disfigure text-books and examinations, though happily in a lessening degree; above all, he should have a training in geometry, beginning with experimental work so as to familiarise him with the matter, and gradually introducing the processes of geometrical reasoning; and if he can be taught the elements of mechanics, beginning also with an experimental basis, so much the better. To give him some power of observation, I would use some of the experimental sciences; my own choice would be the rudiments of experimental physics or inorganic chemistry. But more than all these are wanted; all the studies thus far prescribed are for the purpose of sharpening his wits, and, in the process, they will develop his intelligence. The latter must be developed also in other ways, and to my mind one of the best of ways is to give him a general knowledge of the history of his country, a general knowledge of the geography of the world, and (if possible) some rudimentary knowledge of the modern history of neighbouring countries.

Such a programme provides the elements of a liberal education. A youth, so educated, is ready for the technical training now needed for so many of the occupations of life, and even if he does not devote more time to the continuance of his studies, he is provided with the elements of such intellectual interests as should make him an intelligent man and an intelligent citizen. Also, such a programme is practicable for the average boy; no exceptional ability is needed to have completed such a course at the age of fifteen or sixteen. I am not prepared to say that the average boy at any school in England will have achieved this programme before he is sixteen; if I may judge from some not entirely laudatory criticisms that are openly expressed from time to time and remain unrebutted, it seems to be the fact that the average boy at a public school does not achieve such a programme or its equivalent before he is sixteen. But I am optimistic enough to believe that, in the future as in the past, improvements can come even in English education, and meanwhile I am content to claim that the programme of training which has been sketched is not merely possible, but is practicable also, within the time allowed.

Groups of Students.

Let us assume, therefore, that we have an ample supply of average students who have undergone some not inadequate preliminary training, and, as hopeful assumptions are encouraging, let us further assume that there is more than a sprinkling of students with abilities well above the average. In coming to our ideal university, which is eager to receive them, the students are actuated by varied kinds of needs and desires. Some—many of them, I should like to think—mean to devote themselves to one or other of the different forms of practical business, not intending to use their university education professionally, but preparing to take their part in maintaining and elevating the tone of the community. All the professions and callings, whether learned or technical, are to be recruited from among the students when once they have been trained. Some have the intellectual ambition, more or less defined as yet, ultimately to devote themselves to a life of learning in their own university by preference, yet, if not there, then in some other. There are men intent upon the ministry of religion; there are men intent upon the public service of the State. Last in this enumeration, there are the men of genius, as yet unproclaimed, who are to find in the university that training which will gradually reveal to them their powers, and that stimulus which will inspire them to the highest service of mankind as the discoverers and the thinkers of their generation. To all these men the university must give the means and the opportunities of obtaining the knowledge adapted to their several intellectual needs.

Spirit of University Training.

Of course, every person would be prepared to acknowledge that a university education includes more than even the most industrious and praiseworthy absorption of knowledge, and much of the influence of a university depends upon the spirit and the circumstances in which knowledge is given and received. There is an education of character as well as of mind, and the two can be achieved simultaneously by the due conduct of studies. Thoroughness must be the dominating quality in every study; difficulties which arise must be solved, not evaded; proofs must be sternly examined and only accepted if found valid and clearly comprehended; truth, and not merely comfortable or convenient doctrine, must be the object of search; and all must be done in a spirit that would scorn dishonesty or shuffling about the affairs of the mind as contemptuously

as one scorns dishonesty or shuffling about the property of one's neighbour.

Nor is it less important that the imagination should be stimulated. Some stimulus will come from every study, honestly and thoroughly pursued; according as it is greater or less, so is the greater or the smaller advantage to the student—not then alone, but throughout his life, as affecting his power, his influence, his usefulness. Above all, it is important to have what may be called the play of intellect between the teachers and the students, and, more particularly, in all liberty among the students themselves; it makes for force of character, for steadiness of character, for command over powers, for fairness, for soundness of judgment, for proper confidence in one's self, for proper consideration for others, for toleration, for knowledge of men, and for the seriousness of life. This phase of education is more important than mere instruction, and a university in which it is not secured provides but a maimed and stunted education. It stirs, it moves, it creates, the sentiment felt to the university; its operation has something of the air of spiritual romance, something also of elusive mystery. It cannot be secured by regulations or endowments; it is a product of the spirit of the place and the spirit of the time, difficult to establish as a custom, a treasure beyond value when once established as a tradition.

Each university in its own manner must evolve its own method of establishing this influence; the utmost that its formal regulations can achieve is the due provision for the intellectual needs of all classes of students.

Range of Instruction.

To discharge this duty, fraught with issues so grave to the good of the community, one necessity for the ideal university is that her courses of possible instruction should cover the whole field of human thought and intellectual activity, so that she can take her part in the diffusion and the extension of knowledge. She should possess such a collection of teachers that a student could obtain instruction in any department of knowledge, and could be trained in the use of any method by which knowledge is obtained. All sources of knowledge must be open to all students as they want them; all aids to learning must be provided. She must foster the liberal studies where "nothing accrues of consequence beyond the using"; she must foster the useful studies where the revenue to be produced is of essential consequence. In every art, in every science, in any study which is neither an art nor a science, the spirit of inquiry should be encouraged; and the only dogma permitted to the teacher should be his guiding advice based upon knowledge and experience.

To those who are acquainted with the working of actual universities, my claims may be deemed excessive. But it is to be remembered that I am dealing with an ideal university, and there is no doubt that, in this form of human activity as (I imagine) in all other forms, working practice will be derived from the too lofty ideal by the omission of some of its constituents. Moreover, the omissions may reflect the wishes, the preferences, even the prejudices, of the founders and the supporters; they may also be some index of the neediness of the university in actual work. Whatever their cause, they will tend to vary from one centre to another, and thus each working university will acquire its individual character, and monotony of character will be avoided.

Making this passing concession to the limitations that inevitably cramp the initial stages of great undertakings and sometimes shallow their whole course, let me return to my ideal university where all departments of knowledge are represented, and attempt some classification of these departments so as to give greater clearness and precision to some of its activities. They are set out in the order in which they arose naturally to me when considering them —no other significance, either of preference or importance, is implied in the order.

Position of Theological Studies.

As a preliminary let me deal with a matter which must be settled in the case of each university specifically and particularly—the attitude towards theology. The older among our foundations include its study within the curriculum; the tendency of most of our new foundations is to exclude its study. My ideal university is to make provision for every department of knowledge, and, as theology is undoubtedly a branch of knowledge, she must make provision for the teaching of theology. But in my university, thought is to be free from all fetters of official type, including those imposed by the churches, and the spirit of inquiry is everywhere to be encouraged. These conditions exclude all that part of theology which is expounded definitely on the basis of dogma, and, so far as I see, admit all else. Thus dogmatics, apologetics, pastoral theology, would be excluded; exegesis, ecclesiastical history, the characteristics and distribution of religions, and the history of religion, would be included. Provision would have to be made for the teaching of these latter subjects, and it is more than probable that each of the teachers would have some definite dogmatic position. But of the intrusion of dogmatic views into the exposition of the retained subjects I am no more afraid than I should be of the intrusion of party politics into the academic exposition of history or (what is to be stirred into passionate interest in England in the very near future) into the academic exposition of economics. Nor to my mind is there any arbitrary quality in the action which would include a portion of theology and leave the rest to be obtained, presumably in some theological school of the appropriate dogmatic hue. My ideal university is to include the whole field of human knowledge; but it is not to include everything based on human belief or beliefs, any more than it is to include everything based on human activity, and I do not require it to make provision for the whole training of a dogmatic theologian any more than to make provision for the whole training of (say) a surgeon or an engineer.

Branches of Knowledge, Subjective to Man.

Having now expounded this opinion as frankly as is consistent with the brevity imposed upon me by circumstances, I pass to a review of other activities of the university which usually do not give rise to contentious difficulties. As a beginning must be made somewhere, let us begin with man. We may regard him as engaged in the conduct of his own existence, possessed of mental faculties, directed by certain tastes, exercising mental activities, standing (either as an individual or as one of a group) in multifarious relations with other men; he is placed amid a universe, and there are the phenomena of that universe, living or inert, outside him. Each of these qualities, if they may be so styled, gives rise to a branch or to several branches of knowledge.

Our first quality of man as an existing being has regard to his conceptions of the general nature of knowledge and existence as such, and to the theory of his conduct of his own existence; the branches of knowledge related to those conceptions and that conduct are most simply described by the titles of metaphysics and of moral philosophy or ethics.

His next quality pictured him as possessed of mental faculties. The range of these faculties, their detailed activities, their modes and methods of working, to mention only some of their features, give rise to the branches of knowledge described by the titles of psychology and logic. In theory, there are close relations between logic and mathematics; in practice, particularly the older practice, mathematics as a subject has usually been derived from the study of nature.

Man then was indicated as directed by certain tastes; in this indication, it is mainly his æsthetic faculty that is contemplated. The branches of knowledge associated with the æsthetic element in man are conveniently summarised in the title of the fine arts, meaning thereby the arts of music, architecture, sculpture, and painting, alike in their industrial and their intellectual aspects.

When we contemplate the quality of man as connected with the exercise of his mental activities, not in the mode of the exercise but in its results, we are practically face to face with the intellectual creations of all individuals in the aggregate. The section of knowledge which thus arises is so vast that there is difficulty in finding a single title to describe it. Taking account of such limitations upon the range of this knowledge as are implied in the other activities of man which have been explicitly recited, I shall perhaps most simply describe it as literature.

When we contemplate the quality of man as standing in relations with other men, either as an individual with other individuals, or as a member of a community with other communities, or as a citizen of a State with other States, the branches of knowledge arising through these relations are languages, law, economics, and history.

Thus far, every branch of knowledge indicated has arisen through the consideration of qualities directly appertaining to the individual man, either to himself alone or in association with others. But his circumstances have to be considered. He is placed in a universe, and before there can be any real approximation to a fit understanding of man and his surroundings, the phenomena of the universe must be studied in their facts, their laws, their orders, their significance, their influence. These studies are vast and varied; they are concerned with all the knowable relations of nature, alike animate and inanimate, and they give rise to that immense and ever-increasing ordered body of knowledge, usually called science in general. It includes all the particular sciences, and these may be ranged broadly in the three classes of mathematical sciences, physical sciences, and biological sciences, the first two of which have closer relations with one another than (as yet) either with the third.

Ramification of Studies.

Provision has to be made for the adequate teaching of all these branches of knowledge, and it will be seen that my ideal university is growing at an alarmingly rapid rate. Yet the growth will have to be much greater, in respect even to these branches of knowledge, than the statement can outline, exacting as it seems. Branches of study have been indicated as originating mainly in some one source or other, but any study, once definitely introduced into an ordered scheme of knowledge, may develop into issues vastly wider than its initial purpose. Examples occur at every turn. Languages arose in my enumeration through the relations between man and man; presumably, therefore, they arose for their use in oral communication. But they can be studied for other than utilitarian purposes. They may be studied organically, that is, for their accidence, their syntax, the sources of their words, the analogies and the differences in their methods, their growth and their mutations, their influence upon one another; these, and similar aspects of languages, constitute the science of philology, and provision will have to be made for its teaching. Further, I would make the mild remark that languages, ancient and modern, are the vehicle of literature in the widest meaning that can be given to the word, and a mode of teaching them, which is neither utilitarian (in my sense) nor philological, will be required for appreciation of the best treasures of thought, for comprehension of the records of development of nations, for intelligent understanding of the civilisations of the world.

As for languages, so for history, another of the subjects that in my enumeration arose through the relations between man and man. It may begin in our scheme as the record of the doings of particular peoples; it must develop into the history of mankind to which that of particular peoples is ancillary. The history made up of acts is not more important, rather it is less important, than the history of movements and the development of political thought. Account must also be taken of the fine arts, moral philosophy, religious thought, scientific thought, in that continuous succession which also is their history. For all these, and for the corresponding amplifications of other branches of knowledge introduced initially in the simplest of elementary demands, provision must be made in the university.

Other Branches of Knowledge.

When all this is recognised, and when all the demands thus made are acknowledged and met, then it might be imagined that the necessary provision of the university is complete and that she is fully equipped to discharge all her duties. Far from this being her happy reality, she must afford opportunities for another group of classes of knowledge of an entirely different kind. In the gradual elaboration of the scheme, many useful branches of knowledge have been established; yet in their inception they have been established rather as pure knowledge, and they do not attain their full significance until they have been so organised that the amplest utilitarian tax has been levied on their riches. There thus must be (to use the ancient word) a faculty of theology, a faculty of law, a faculty of medicine and surgery; though just as not all theology can be taught in the one faculty, for dogmatics have been excluded, so neither all the practice of law nor all the clinical elements of medicine and surgery can be taught in their respective faculties in the university.

Nor is this all. These practical organisations have been selected as being subjective to man, but they are not complete even within that categorical limit. Growing academic thought has discovered that other organisations of knowledge can fitly be framed; Birmingham now possesses a department of commerce, Cambridge has just established a new curriculum in economics, and not in one university alone has provision been made to meet a growing sense of the need for a department in the history, the theory, and the art, of education itself.

The tale of demands is not yet full. Only those branches of useful knowledge have thus far in the scheme been selected for utilitarian organisation which are most closely associated with man's health and man's human relations. There still remain those other branches of useful knowledge which, fitly organised and selected, will train men to wield the forces of nature for the advantage of the community. Perhaps the most conspicuous example of such a group of branches of knowledge is provided by the school of engineering which certainly must exist in our ideal university, to include instruction in electrical engineering, in mechanical engineering, and in naval engineering; and other examples, following the wisdom of recent establishments, will be given by a school of agriculture, a school of tropical diseases, and departments of particular industries depending largely upon the locality of the university. It lies with the future gradually to work out the balance between practice and training, and to settle the proportion between experiment and experience, in the equipment for professions of the newer order as has been done for the professions of medicine and surgery. And let me add two warnings. While the earlier stages in any such process continue, there is more than a probability that old ideas as to what constitutes a university education will receive rather rude shocks, and may occasionally be staggered. I would, very respectfully, urge a caution against the exclusion of any subject of new technical knowledge from the university, either actual or ideal, if only because no man can foretell its possible tribute to even abstract theories; I would suggest that its prudent reception in a not too unsympathetic spirit is a preferable mode of exercising the caution of academic wisdom. On the other side, the fiery and occasionally arrogant advocates of devotion to the newest learning would do well to temper their vehemence with intellectual charity. Before they came upon the scene, thought had propounded problems which their sciences cannot touch; after they shall have left it, thought will continue to propound problems equally unamenable to their sciences.

Extension of Knowledge: Research.

Hitherto, I have spoken of the university as a treasury of all ascertained knowledge which is to be given without stint to all qualified students coming for its wealth, and those who distribute this wealth are the professors and other teachers. But that duty, no matter how excellently discharged, is not the sole duty of these officers in respect of knowledge; if it were, the university would only be a rather glorified secondary school. It is true that we have not supposed our ranges of study to be confined to antique knowledge which is crystallised; on the contrary, all knowledge is to find its home in our university and, at the fitting stage, the students will be brought into contact with living knowledge, growing, increasing, and in its very vitality proving the greatest stimulus to the ardent mind. You would not be content that the estimates of literature should only be those of some bygone generation. The last word in judgment of painters and painting had not been uttered when Ruskin finished his great book. Almost from day to day, a chapter in the history of civilisation anterior to the Greeks is being opened up by the discoveries in Crete. Not all the problems of history are solved, and their solution will add to the knowledge of the past, perhaps to the

comprehension of the present. After the past week, you will not need to be told in detail how, in every direction, the sciences, abstract, concrete, practical, are advancing by leaps and bounds. Progress is the condition, it is the essence, of living knowledge; it should be the very breath of life of the university.

How is this progress to be secured, and the knowledge of it made available? It is manifestly the duty of the professors to assimilate new facts as they come, and to submit them to those critical refining and concentrating processes which make the surviving product some contribution to truth. But is there to be nothing else on the part of the professors? Is it to be "all take and no give"? all absorption and no production? Are they to profit by taking toll of all the thought of the world, and to contribute nothing for toll in return? I hold it to be the highest duty of a teaching professor that, up to the limits of his powers, he should strive to contribute to the increase of knowledge and the advancement of truth.

Now I know that all professorial spirit is not the same spirit. There is a spirit which devotes itself to administration; its works deserve grateful acknowledgment, and they are undoubtedly indued with the exercise of power, so dear to many souls. There is a spirit which devotes itself to the humanising and social influences that should be a feature in the life of a university; its labours are blest in a quickened vitality that affects the whole community. But the spirit of research must also be there; not alone the quest of facts, but the quest of truth, which is higher than facts; not alone the love of novel thought, but the love of wisdom, which is the crown of thought. You cannot secure it by regulations; a professor will devote himself to research in proportion as he likes it, not because it is an expected duty. You cannot exact it from every professor; but there must be a substantial amount of research produced by the aggregate of professors, or their corporation will fail to contribute its share to the advancement of learning. Moreover, in the absence of research, the university will fail in other respects, for it will be unable to exercise the profoundest of all influences upon the most earnest of its students whose later duty it will be to carry on the torch of learning—I mean the influence of stimulus and inspiration.

Will you let me be reminiscent for a few moments? When I was an undergraduate at Cambridge studying mathematics in all the earnest and kindly rivalry that is frankly and easily possible among young men who are friends, there was, among the professors, a group of four men of supreme eminence, Stokes, Cayley, Adams, and Maxwell. We were not (or we thought we were not) sufficiently qualified by our attainments to attend their lectures in our earliest days; but our teachers could tell us of their powers, their genius, something of what they had done or were doing, and we knew that they stood among the great men of the world. Do you think it was a little thing to young men at the opening of life that they belonged to a university which possessed such illustrious pioneers of learning? I can tell you that, though the young men then knew themselves hardly worthy of entrance even into the court of the Gentiles in the temple of new knowledge, the mere presence of the great men stimulated them and inspired them along the paths which led to the temple. I have spoken of one group of professors, great men in the domain of knowledge that was our special pursuit; I would mention another group of professors possessed by Cambridge at that time, equally great in another domain, that of theology. They were Lightfoot, Westcott, Hort. To theological students I suppose that they stood for as much as did the mathematical group to us; but even to those of us who were not theological students their achievements made the university a more stimulating home of study, though we knew nothing in detail of their work. All these men are dead, the oldest of them all only a few months ago; their bodies are buried in peace, but their names live for evermore, a treasured inheritance and the proud possession of the university of which during their lives they were an ornament, a glory, and an inspiration.

This deviation into personal reminiscence is undoubtedly an interruption of my main line of argument. Yet these particular examples of fact may do more than any ordered sequence of reasons could do for the establishment of my contention that a healthy university must contribute not merely to the diffusion of knowledge, but also to the advancement of learning.

CONCLUDING REMARKS.

I have spoken at length of some of the aspects of universities, and have incidentally alluded to others, and some have been omitted entirely. It is time, however, that my remarks should draw to a close, and so I leave the subject with you at this stage. Earlier in the evening I confessed that the receipt of the charters of the Universities of Manchester and of Liverpool suggested my subject. But the real reason for its selection was a desire on my part to do something by way of concentrating your thoughts, and, through you, the thoughts of others, upon the significance of university education, for I believe that a vigorous university can exercise a most beneficent influence upon the life of a nation. It certainly can play its part in so training men that they can contribute to the commercial success and the material welfare of the people among whom it is placed. But it can do more. The greatness of a people is not to be measured solely or even mainly by its commercial success, or the extent of its empire, or the vigour of its fighting powers. Thought has its part in life, no less than action; frequently it dominates action; often it is more potent than action in its influence upon the course of civilisation. In estimating the position of a nation in the scale of the world, not a little weight ultimately is attached to its devotion to learning. The spread of learning makes for the clearer understanding of the nations by one another, and consequently assists towards developing feelings of comity and invoking the spirit of peace. Universities can do much as agents in the achievement of these aims as of others that are more utilitarian. They give to their people a wider range of knowledge and a higher standard of culture, and they can organise the genius and the ability of a nation so as to feed the living springs of action and enable it to make no unworthy contribution to the growing thought of the world.

ASTRONOMY AND METEOROLOGY AT THE BRITISH ASSOCIATION.

THE proceedings of the department of Section A which was devoted to astronomy and meteorology were conspicuous this year on account of the meeting of the International Meteorological Committee, which was held during the Association week, and brought to Southport not only representative meteorologists from the United States, France, Germany, Austria, Russia, Sweden, Norway, Denmark, Holland, and the Azores, but also a very notable gathering of British meteorologists. The muster at the meteorological breakfast, which was organised by Dr. H. R. Mill, was not less than sixty-two.

International Committee Meetings.

The meetings of the International Committee, under the presidency of Prof. Mascart, and of the Subcommittee for International Telegraphy, under the presidency of Prof. Pernter, were so arranged that the members could attend the meetings of the department. Several of them made communications to the section and took part in the discussions. The variety of language added to the interest of the proceedings, which were in gratifying contrast with the rather depressing occasions represented by the meteorology days as they used to be before the formation of a special subsection for cosmical physics.

Before going on to the work of the subsection, a word or two may be said about the work of the International Committees. First, for the subcommittee on weather telegraphy: its duty is to consider all matters which concern the efficiency of the arrangements for daily weather maps. In Europe these arrangements are of the most complicated character, and require the cooperation not only of a number of independent meteorological services, but also of an equal number of independent telegraphic services bringing messages, not as a rule from the centres of business, but from the most remote and exposed positions on the European coasts to the various central offices. The relations between

the several services are partly by way of exchange and partly by way of payment for services rendered, and complication is inevitable.

Considering the difficulties to be overcome, and the divergent interests of the different offices, the results already achieved, as represented in the weather maps of Europe, are a remarkable witness to the spirit and capacity with which the predecessors of the present committee have approached the subject. There are still some questions outstanding, for which a solution is obviously desirable, connected with the hours of observation and the time occupied in the transmission of the despatches. But questions of the observations and their transmission are so mixed up that they are as much matters for the telegraphic services as for the meteorological offices. Accordingly, the tendency of the committee, after prolonged consideration of many details, was towards a conference with the International Telegraphic Convention, and the work was devoted to formulating the questions which might be profitably raised in such a conference.

The International Committee itself is somewhat informal in its proceedings. It begins formally enough by recording changes in the personnel, which may have been already arranged by correspondence, and receiving reports from its Subcommittees. On this occasion these included, besides the report of the Telegraphic Subcommittee already mentioned, an important and final report from the Committee on cloud observations, the results of which were subsequently given to the Association by Prof. Hildebrandsson, and an account of the work of the Aëronautical Committee, of which results have been already published by the German Government, and which were also referred to subsequently in the proceedings of the section. To this was added, as a supplement, an account by M. Teisserenc de Bort of the Franco-Scandinavian aëronautical station in Jutland, established by him in 1902 with the cooperation of the meteorological authorities of Denmark, Sweden, and Norway. Other work in connection with the exploration of the upper air was mentioned.

The committee then went on to consider various proposals for the extension or improvement of observations, referred to the committee or made by individual members, among which were to be found proposals for the organisation of observations of atmospheric electricity referred by the Academy of Science of Saxony, the institution of regular observations of solar radiation, and various other matters of a more or less technical character; an account of these details will be given in the official report of the proceedings. An English translation of the report will be published as usual by the Meteorological Council.

Two important resolutions, one appointing a subcommittee to organise a committee for dealing with simultaneous solar and terrestrial changes, and the other directing the attention of the British Association to the inconveniences of the present practice of having different systems of units of measurement for meteorological observations, are referred to later on.

At the close of the meeting of the committee, at which a cordial vote of thanks was passed to the Mayor and Corporation of Southport for the use of the committee room of the Town Hall for the meetings, the following future international assemblies were announced:—In 1904, a meeting of the subcommittee for terrestrial magnetism at Cambridge, and a meeting of the aëronautical subcommittee at St. Petersburg; in 1905 a conference of directors of meteorological offices and observatories at Innsbrück.

Meetings of the Department for Astronomy and Meteorology.

Meetings of the subsection of the Association devoted to astronomy and meteorology were held on Friday, September 11, and the following Monday, Tuesday, and Wednesday. During part of the session of Monday and on Tuesday meetings of the remainder of the section were held, simultaneously with those of the department, for the discussion of papers on mathematics and physics.

The proceedings on September 11 commenced with the chairman's address, which has already been printed in these columns. Arising out of a vote of thanks proposed by Prof. Schuster, there came what may prove to be an important suggestion, that the time has now arrived when meteorologists of all countries should adopt a uniform system for the measurements of pressure and temperature. Those quantities have certainly been measured long enough for men of science to be able to agree as to what is the most scientific and the most practical way of expressing them. The result of Prof. Schuster's suggestion appeared first as a communication from the International Committee, and subsequently as a resolution upon the subject by the General Committee of the Association. The address was followed by a discussion of simultaneous solar and terrestrial changes, introduced by the president of the Association, Sir Norman Lockyer, in a paper which gave a short account of the history of the various measurements that have been made bearing upon the subject. In association with this paper, a paper by Dr. Buchan on the distribution of rainfall in Scotland in relation to the sun-spot period was taken, and a general discussion followed, in which Dr. Hellmann, of Berlin, referred to the work done in Germany upon the subject, and Father Cortie, of Stonyhurst, opposed the view that the connection between solar prominences and terrestrial phenomena is directly one of cause and effect. When the subject was subsequently considered by the International Meteorological Committee, a subcommittee was appointed to carry on its further development. The original members named are Mr. Shaw, Prof. Pernter, Sir Norman Lockyer, Prof. Langley, and M. Angot. Upon these now devolves the duty of organising the subcommittee for the furtherance of the object in view. After the discussion, M. Teisserenc de Bort read a paper in French, "Sur les dépressions barometriques," in which he traced in detail the vertical structure of barometric depressions as determined by observations of the upper air. In the afternoon Messrs. Grossmann and Lomas exhibited some interesting pictures illustrating the origin and forms of hoar frost obtained in a refrigerating chamber.

On Monday, September 14, the proceedings opened with a paper in German by Prof. Pernter, of the Austrian Meteorological Office, upon the use of the hair hygrometer in place of the psychrometer for purposes of ordinary observations of humidity. The contention of the paper was that both instruments required empirical graduation, and that if the same trouble were devoted to the empirical graduation and management of the hair hygrometer as is now required for the psychrometer, the results would be more satisfactory. Prof. Pernter exhibited a specimen of the instrument in which no pulley was used, and one important cause of objection to the hair hygrometer was thus avoided. He also exhibited a very interesting photograph from the Sonnblick of a portion of a halo which had been predicted on theoretical grounds, but had never been observed before, as it is formed below the horizon line. Attention was next turned to astronomy by a paper of Prof. Turner's on the question, "Was the new star in Gemini shining previously as a very faint star?" On photographs of the region taken by Dr. Max Wolf at Heidelberg and by Mr. Parkhurst at Yerkes, a faint star is shown very near the place of the Nova; but the evidence was on the whole against identity, and this conclusion was confirmed by a letter from Prof. Barnard, received on the morning of the meeting, announcing that he had observed the faint star shining beside the Nova. The subsection then reverted to meteorology, and listened to a very important paper by Prof. Hildebrandsson, of Upsala, upon the results of the international cloud observations and their effect upon the general theory of the circulation of the atmosphere. Prof. Hildebrandsson first exhibited a reproduction of a drawing illustrating James Thomson's theory of the general circulation, which is practically similar to the scheme of general circulation adopted by Ferrel. He then showed a series of diagrams representing the motion of the upper atmosphere as determined by the motions of cirrus clouds deduced from cloud observations in all parts of the world. In some cases, also, the motion of the lower clouds was given. The general system of circulation thus established was shown to differ in most important particulars from the calculated circulation of Thomson and Ferrel. In the discussion an interesting point was raised by Prof. Hergesell as to the extent to which the motion of air could be inferred from the motion of clouds, clouds only being formed in certain states of the atmosphere; but the question was not solved.

The subject of kite observations and the general investigation of the upper atmosphere was then taken up. It was introduced by Mr. Dines, who gave an account of the work of the kite committee of the Association and of the difficulties met with in carrying out the continuation of the observations in the summer of this year off the west coast of Scotland. Dr. A. L. Rotch followed with an account of the kite observations at Blue Hill in the years 1900–2, and Prof. Hergesell added an account, for the most part in German, of the work of the International Aëronautical Committee. He concluded in English with an eloquent appeal to the science of this country to take a part in this important investigation. The three papers mentioned were followed by a general discussion, which had not concluded when the morning sitting of the section was adjourned. It was accordingly postponed until the following day, and then continued by Profs. Schuster, Turner, and M. Teisserenc de Bort. The matter was subsequently brought before the committee of Section A, and at their instance the General Committee at their final meeting adopted a resolution urging the council to take steps to secure the means of joining this international enterprise. The papers in the afternoon were one on photographs of the Orion nebula, by Mr. W. E. Wilson, showing what could be done by screening to bring out in a positive detail of the central overexposed regions of the negative, while preserving the faint extensions; on the spectra of lightning, by Dr. W. J. S. Lockyer, which formed a suitable companion to the author's fine collection of photographs of lightning in the meteorological exhibition, and which was further elucidated by a photographic spectrum of lightning from Yerkes Observatory; and also a paper by Mr. D. Burns, attributing some of the unexplained phenomena accompanying volcanic eruptions in the West Indies to electrical action.

On Tuesday, September 15, Prof. Milne, whose ill-health during the meeting of the Association unfortunately prevented his taking much part in the proceedings, read the report of the seismological committee, and gave an account of his conclusions on the present state and properties of the interior of the earth. That was followed by a number of astronomical papers. Prof. Hale sent from the Yerkes Observatory a series of very fine photographs made with the new Rumford spectro-heliograph mounted on the 40-inch refractor. By setting the slit in different parts of the K line he is able to photograph the distribution of calcium vapour at successive heights above the photosphere, and to show how the calcium "flocculi" expand as they rise and spread out over the spots. He announced also the existence of *dark* hydrogen flocculi and of occasional dark calcium flocculi. Prof. Schuster contributed a very important paper on radiation from a foggy atmosphere, finding in the "scattering" of light by molecules an explanation of the fact that a star may show the hydrogen series partly bright and partly dark. A paper by Prof. Sampson announced some of the results of the eclipse observations of Jupiter's satellites upon which he is now engaged; and one by Father Cortie on solar prominences and terrestrial magnetism went to show that no direct relation in detail could be traced between individual prominence outbursts on the sun and terrestrial magnetic storms. The conclusion was that both depend on some deep-seated common cause, and not directly one upon the other. There followed a paper by Dr. Paulsen, of Copenhagen, in which the spectrum of nitrogen was compared with the spectrum of the aurora obtained by long exposure in the Arctic night of Iceland. Dr. Buchan gave an account of the results of an investigation of the variation of temperature in the water of the Levant, which regularly gains temperature during one part of the day and loses it all again within the twenty-four hours. This gain and loss Dr Buchan attributed to the effect of absorption and radiation. The decision between that hypothesis and the alternative suggested by Mr. J. Aitken, that it might be accounted for by convection, was left as an attractive subject for further consideration.

The work of the day concluded with some magnetic papers, Prof. Schuster reading for Dr. Bauer, first an account of the progress of the magnetic survey of the United States, and secondly an attempt to compute the secular variation of the earth's total magnetic energy. The report of the committee of the Falmouth Observatory, to which the Association is giving a liberal subsidy, in order to maintain a self-recording station free from the electrical interference which has destroyed the usefulness of the Kew observations, until a new national magnetic observatory is established, was merely formal.

The subsection continued its labours up to the end of the available time of the Association. On Wednesday, Dr. W. J. S. Lockyer read a paper on the relation between prominences, sun-spots, and coronæ. Dr. Buchan produced the twenty-first report of the committee on Ben Nevis Observatory, which concluded with a summary of the results as bearing on forecasting. Prof. Callendar gave an account of the electrical self-recording instruments designed by himself, and pointed out their advantages over those in general use. There are so many points in connection with the practical use of self-recording instruments to which it is desirable that attention should be directed that it is to be regretted that the limited time of the section did not permit more extended discussion of the general question. Dr. A. L. Rotch gave an account of the results of his experiments at Blue Hill upon the effect of meteorological conditions upon the audibility of sounds between a high-level and low-level station. The results were of a negative character on the whole; no specific effect could be attributed to differences of meteorological condition. The business concluded with a paper by Dr. Mill on some rainfall problems, in which he discussed some practical difficulties arising in the construction of accurate rainfall maps. The usual vote of thanks concluded the proceedings.

Exhibition of Objects of Interest in Meteorology, Terrestrial Magnetism, &c.

In connection with the meeting of the International Committee, an exhibition of objects of interest in meteorology and allied subjects, terrestrial magnetism, solar physics, seismology, &c., was organised. The preliminary arrangements were made by a committee which met at the Meteorological Office, and consisted of representatives of the Meteorological Council, the Royal Meteorological Society, the Scottish Meteorological Society, the president of the Association, the Astronomer Royal, the director of the National Physical Laboratory, and a number of others interested in the subjects represented. The result was the collection of a large number of very interesting exhibits from the following exhibitors:—

The Admiralty, Hydrographic Department, magnetic apparatus; the Astronomer Royal, historical instruments, magnetic and meteorological records; the Meteorological Council, books, maps, diagrams and automatic records; the National Physical Laboratory, Kew Observatory, McLeod's sunshine recorder, cloud apparatus and photographs, records and diagrams illustrating meteorology, magnetism and seismology; Prof. A. A. Rambaut, Radcliffe Observatory, barograms showing disturbances due to volcanic eruptions, and diagrams of the results of earth temperature measurements; the Royal Meteorological Society, Glaisher's balloon apparatus and other objects of historic interest; the Scottish Meteorological Society, photographs of Ben Nevis and special rainfall maps; Sir Norman Lockyer, F.R.S., Solar Physics Observatory, diagrams of solar phenomena and of the secular variation of pressure in different parts of the earth; M. Teisserenc de Bort, records of unmanned balloon ascents etched on metal sheets; Mr. John Aitken, F.R.S., dust counters and koniscope, with a map exhibiting some results obtained, and an apparatus illustrating certain phenomena of cyclonic storms; Mr. J. Baxendell, new self-recording apparatus for temperature and for wind direction combined with wind force, diagrams and records from the Fernley Observatory, Southport; Mr. F. F. Blackman, apparatus for demonstrating and measuring the evaporation of water from the leaves of growing plants; Mr. F. J. Brodie, diagram of gales; Dr. Buchan, F.R.S., meteorological atlas; the Cambridge Scientific Instrument Company, Callendar recorders for temperature and sunshine, and Blakesley's portable barometer; Captain E. W. Creak, R.N., C.B., F.R.S., magnetic charts; Mr. W. H. Dines, tornado cloud apparatus and kite records; Mr. F. L. Halliwell, new self-recording rain gauges; Mr. F. W. Harmer, diagrams of suggested isobaric distributions in the Glacial

epoch; Mr. J. J. Hicks, various apparatus, including a standard thermometer without any error shown in the Kew table of corrections between 32° and 212°; Dr. W. J. S. Lockyer, photographs of lightning and of the spectrum of lightning; Dr. H. R. Mill, rainfall maps; Mr. R. W. Munro, new pressure plate anemometer by Dines; Messrs. Newton and Co., altimeter; Prof. J. M. Pernter, new self-registering electrometer and anemometer, also hair hygrometer and photometeorometer; Mr. A. Lawrence Rotch, instrument for determining the velocity of wind at sea, kite investigation exhibits, photographs of high-level stations and of the figures of the winds from the Horologium at Athens; Dr. R. H. Scott, F.R.S., Russian climatological atlas; Dr. W. N. Shaw, F.R.S., Galton's "Meteorographica" and other historical exhibits, lantern slides, apparatus and diagrams illustrating the motion of air in circular storms, and apparatus illustrating the circumstances of the formation of cloud in free air; Prof. F. T. Trouton, F.R.S., gravimetric recording hygrometer, and an electrical dew-point hygrometer; Mr. C. T. R. Wilson, F.R.S., experiments on ionisation; Commander Wilson-Barker, R.N.R., cloud studies—photographs; Dr. W. Mansergh Varley, for Mr. P. Y. Alexander, *ballons sondes* records; Mr. A. Lander, new sunshine recorder, anemometer, and thermograph.

It is difficult to particularise in a short notice the exhibits which deserved or those which received the greatest attention. Not the least interesting was the one representative of the connection of meteorology with botany, exhibited by Mr. Blackman, an apparatus which showed the rate at which water evaporated from the leaves of the branch of a tree. From the point of view of meteorology, probably the most important exhibits were the comparatively inconspicuous sheets of metal or paper on which were recorded the results of balloon or kite ascents by M. Teisserenc de Bort, Mr. Rotch, Mr. Dines, and Dr. Varley, one of the records exhibited by the last-named gentleman extending to the height of 70,000 feet. The opportunity of seeing the working of Mr. Aitken's dust counters, Mr. Wilson's experiments on the effect of the electric field upon condensation of water particles, with other noteworthy experiments, the collection of weather maps of all countries, of magnetic apparatus old and new, and of the diagrams bringing together the results of observations from all parts of the world, will probably remain among the most satisfactory recollections of the meeting in Southport. The local exhibits by Mr. Baxendell, of the remarkably well equipped Fernley Observatory, and his assistant, Mr. Halliwell, were admirable examples of the best kind of progress in meteorological instrument making, and a word ought to be said for Mr. Lander, of Canterbury, who exhibited some self-recording instruments of his own construction, among others a sunshine recorder which keeps the record of sunshine for a month on a half-plate sheet of photographic paper.

An interesting exhibit, which could not be confined to the four walls of a building, was a specimen of the mortars used in southern Europe for bombarding the clouds, as described in the columns of NATURE, vol. lxiv. p. 159. The apparatus was brought and exhibited by Prof. Pernter, being placed at his disposal by the makers for the demonstration of the remarkable vortex rings which are produced by the discharge of the mortar, which is provided with a large funnel-shaped attachment. The discharges were directed horizontally, and though the rings did not carry smoke enough, as a rule, to be easily followed by eye, some of them showed their structure and others could be heard hurtling along the promenade for a considerable distance.

Finally, mention should be made of the arrangement carried out in connection with the exhibition by the Meteorological Council for the preparation at Southport of a weather chart of north-west Europe with remarks and forecasts in the same manner as those of the daily weather report of the Meteorological Office. For this purpose the reports of observations received in London were sent on by telegraph to Southport, and there charted and dealt with; the evening information of which account has always to be taken in preparing morning forecasts was sent by post and charted in readiness for the arrival of the telegrams.

A special feature of the Southport edition was found in maps of the distribution of maximum and minimum temperatures, sunshine and rainfall for the previous twenty-four hours, which replaced the three supplementary maps of the daily weather report.

The primary object of the arrangement was to enable the members of the British Association to examine for themselves the method adopted by the Meteorological Council for dealing with daily weather information, but it was also an experiment by which one can estimate the conditions necessary for carrying out a system of distributing telegraphic information to local centres to be there dealt with independently of, but in association with, a central office. At present in this country there is only one centre for the preparation of reports and forecasts, although the local conditions of the three kingdoms are very complex. The trial of the preparation of independent reports from the same data is therefore of more than temporary interest.

In the chapter of accidents it came about that the Southport week exhibited remarkably typical examples of British weather, including the rapidly travelling circular storm of September 10, with accompanying heavy rainfall, and the persistent anti-cyclone of the following week, with its autumnal mornings and atmospheric effects. Unfortunately all the types were cold, and the visitors from over sea were more impressed with the meteorological interest of the week's weather than with its geniality. The series of maps remains a very interesting group of specimens for weather study.

W. N. SHAW.

ARCHÆOLOGY OF THE COAST OF NORTH-WEST FLORIDA.[1]

MR. CLARENCE B. MOORE has concluded his thorough archæological survey of the coast-line of north-west Florida. Although this district had not previously been investigated, many mounds had been opened by treasure seekers and curiosity hunters, and thus valuable data have been lost to the students of American archæology. This irresponsible exploitation of mounds for spoil has caused great loss to science in America, but the loss in the Old World has been infinitely greater, and too often this ignorant digging has been carried on under the auspices of "learned" institutions.

By far the greater portion of Mr. Moore's finds consists of pottery which has been added to the noble collection that this enthusiastic archæologist has given to the museum of the Academy of Natural Sciences at Philadelphia. Indeed, there are in the various museums of the United States enormous collections of pre-Columbian and more recent pottery, comparatively little of which has been studied or published. It is to be hoped that ere long one of our American colleagues will give us a monograph on American ceramics as a whole; a work on this subject is much needed at the present day, and it could not fail to be of very great interest.

There is so much variety in the vessels so numerously and beautifully figured by Mr. Moore that it is difficult to give an idea of the pottery of the district investigated. Many vessels are composed of several cups or receptacles, most are of irregular form and are often provided with animals' heads, a few are perforated, and some are in the form of human effigies; a unique vessel has the form of an inverted truncated pyramid, on one side of which a human figure peering over the edge is modelled in relief. The majority of the vessels are decorated in various ways, usually either by incised lines or by devices or patterns in low relief, many of which look as if they had been produced with a stamp; one simple cylindrical vessel is ornamented with an incised design representing two human hands, but most of the designs and patterns have no obvious significance.

A good many human crania have been found, and these exhibit great antero-posterior flattening, while in some a concave depression gives evidence of early constriction by a band. Captain Bernard Romans, who was familiar with

[1] "Certain Aboriginal Remains of the North-west Florida Coast." Part ii. By Clarence B. Moore. (*Journal* of the Academy of Natural Sciences of Philadelphia, 2nd series, vol. xii., part ii., 1902.)

this part of Florida, writing in the latter part of the eighteenth century, tells us that in his time the Choctaws bound bags of sand to the heads of male children; but skulls of females exhibit the same artificial deformation.

The region investigated by Mr. Moore shows in an interesting manner the influence of other districts. The pottery of north-west Florida is, on the whole, much superior to that of the peninsula, and the author is inclined to believe that the best ware found its way into the latter region through barter, and the comparative rarity of the imported ware may account for the infrequent occurrence of earthenware vessels in the burial mounds of the coast of the peninsula.

In the first part of the report (*Journal* Acad. Nat. Sci., Phila., xi., 1901, p. 439) Mr. Moore noted a mortuary custom prevailing in peninsular Florida, which consisted of knocking a hole in the base of a vessel, presumably to "kill" the pot, that its soul might accompany that of the dead man. The flimsy and "freak" pottery sometimes found in the peninsula, and numerously in the north-west, was made expressly for interment with the dead, and in the base of each vessel a hole had been made previous to the baking of the clay. A new feature in "freak" ware was encountered about St. Andrew's Bay; these vessels

FIG. 1.—Perforated mortuary vessel from St. Andrew's Bay, Florida.

were life-forms, usually, but differed from other life-forms of the same district in that they were inferior to them as to ware and workmanship, and that they had various perforations, made previous to baking, in the body of the vessel as well as the customary one in the base.

Mr. Moore also obtained evidence which suggests that the flesh was removed from the bones of the corpses and burnt; the mass of carbonaceous matter was always found on the eastern side of the mounds. Urn burial was largely in vogue in Alabama and Georgia; it extended into Florida, but practically is not met with further east than St. Andrew's. Inhumation was almost universally practised in Florida; true cremation has not been met with in the peninsula, but it was occasionally practised on the mainland, or north-western portion. These observations confirm the statement of Cabeça de Vaca, who spent some years among the aborigines of the north-west Florida coast; he says that persons there in general were buried, but that doctors were cremated. Mr. Moore is to be warmly congratulated on having brought his labours to so successful a termination, and the Philadelphia Academy of Natural Sciences is fortunate in possessing so liberal a benefactor. It is to be hoped that these instructive collections will be suitably and worthily displayed.

A. C. H.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—In accordance with general expectation, Dr. J. N. Langley, F.R.S., has been elected professor of physiology in succession to Sir Michael Foster, K.C.B., F.R.S.

Dr. A. Hill has been reappointed university lecturer in advanced human anatomy. Dr. A. C. Ingle has been appointed university lecturer in midwifery. Mr. J. de Gruchy Gaudin has been appointed a governor of the University College of North Wales, Bangor.

An Allen studentship of the value of 250*l.* for one year, for research in any branch of study connected with medicine, mathematics, physics and chemistry, biology and geology, or moral science, will be vacant next term. Candidates must be graduates of the university and not more than twenty-eight years of age.

Mr. Newall will lecture next week on Hale's recent investigations of the sun's surface, with illustrations obtained from Prof. Hale, of the Yerkes Observatory.

The State Medicine Syndicate reports that during the present year eighty-eight candidates have presented themselves for examination in sanitary science. Forty-one were successful in obtaining the university diploma in public health.

Sir Walter Gilbey has been appointed an additional member of the board of agricultural studies.

A syndicate is to be appointed "to consider what changes, if any, are desirable in the studies, teaching, and examinations of the university, to confer with any persons or bodies, and to submit a report or reports to the Senate before the end of the Easter term, 1904." The members proposed are the Vice-Chancellor, Sir R. C. Jebb, Dr. A. W. Ward, Mr. Austen Leigh, Mr. W. Chawner, Dr. D. MacAlister, Prof. A. R. Forsyth, Dr. J. N. Keynes, Prof. J. J. Thomson, Mr. R. S. Parry, Mr. J. W. Cartmell, Mr. W. Durnford, and Mr. W. Bateson. It is understood that one of the first questions to be considered will be that of "compulsory Greek."

THE War Office has sanctioned the provision of a guard of honour on the occasion of the visit of Lord Kelvin to Cardiff to receive an honorary degree from the University of Wales.

THE Commissioners for the Exhibition of 1851 have offered a nomination for an 1851 science exhibition to the South African College, Cape Town, for 1904, and hope to repeat the offer in 1906 and subsequent alternate years.

DR. C. S. MYERS has been elected to the lectureship on experimental psychology at King's College, London, rendered vacant by the resignation of Dr. W. G. Smith, who has been appointed to a similar post at the University of Liverpool.

THE Prince and Princess of Wales will visit the Battersea Polytechnic on Wednesday, February 24, for the annual distribution of prizes to evening students and the formal opening of a new block of buildings in the women's department.

AT the half-yearly meeting of the governors of the University College of North Wales, held on October 28, the chairman stated that in all probability 5000*l.* would be received from the trustees of the late Dr. Evan Thomas, and that it had been decided to allot that sum to the new building fund.

A NEW Royal college at Posen was opened on November 4 by Herr Studt, the German Minister of Education. Herr Studt, in declaring the building open, referred to the Emperor's deep interest in the education of eastern Germany, to which the new college largely owed its existence. The new foundation was to be a university in the true sense, he continued, for it would serve the needs of all the population, including even that section of the Poles which still held aloof.

THE civic inauguration of the University of Liverpool took place on November 7 in St. George's Hall, Liverpool. The Lord Mayor of Liverpool presented the charter of the university to the Chancellor, remarking that no one had

done more than Lord Derby to further the movement for the establishment of the university. Lord Derby, on accepting the charter, said they could now hope that the new university would become the centre of learning of a great, active, industrious, and well-employed population. Sir Oliver Lodge, who took part in the proceedings, remarked in the course of a speech that something substantial must be done for higher education. Hitherto the country had been content to leave this to private munificence, and private munificence had done well, but unaided it was unequal to the burden. He trusted it was not impolitic for him to say, without regard to party questions, that he regretted that a registration duty which was doing no harm, and was hardly a subject of controversy, should have been flippantly thrown away when no longer needed for the Exchequer, instead of being ear-marked for higher education. That amount would have been sufficient to put the education of the country on a sound, thorough, and, indeed, magnificent basis, and would have enabled them to hold up their heads once more amongst the educated nations of the world. Referring to local support, Sir Oliver Lodge expressed the hope that whatever aid was given by the municipality, they would not abolish fees. It was only just, right, and natural that those who specially utilised the institution should make special contributions to it, but by all means they ought to provide scholarships for unmoneyed ability. His advice was that the scholarships should be provided as little as possible on the basis of competitive examination and as much as possible on the basis of nomination from schools and institutions to which the scholarships were assigned.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, June 18.—"On the Magnetic Expansion of the Less Magnetic Metals." By P. E. **Shaw**, B.A., D.Sc. Communicated by Prof. J. H. Poynting, F.R.S.

Research has been made by various observers, notably Nagaoka and S. Bidwell, on the relation between field (H) and expansion per unit length ($\delta l/l$) resulting from that field of the metals iron, nickel and cobalt. Bismuth also has been tested, but the consensus of opinion is that it shows no expansion under any field so far applied to it. Outside the ferromagnetic group bismuth has the largest susceptibility (k) of any substance, and the tacit assumption seems to have been made that if bismuth shows no expansion, it is vain to look for it in less susceptible metals. But there is no direct relation between k and $\delta l\ l$; iron has maximum k six times as much as nickel, and yet expands far less than it for any known field, and so on.

It seems possible, therefore, that there may be appreciable movement for large fields in the case of metals other than the ferromagnetics. This paper gives an account of tests applied to specimens of bismuth, silver, aluminium, copper, zinc, brass, bronze, lead and tin. It is very difficult in working with large fields to avoid movements due to induction and attraction of iron (if any) in the apparatus, or to solenoidal suction or to a straining of the magnetising coil to set itself in the earth's field. These movements are small, but the apparatus is very sensitive, as it measures any movement more than 4×10^{-9} of the length of the specimen (19 cm.). The measuring instrument was the electric micrometer. By great care and repeated change in the arrangement these sources of error were eliminated, and it was found that no movement (more than the amount stated), positive or negative, occurs for any field up to the large one of 1900 C.G.S. No previous tests have been applied to any of these metals except bismuth. Bidwell has tested this metal with a field of 1500 C.G.S., and with a measuring apparatus which would show a movement of $1{\cdot}4\times10^{-8}$ of the length of the specimen, yet no movement was found. No other test has been so searching as the above. This definite negative conclusion involves two corollaries. (*a*) It is generally supposed that the small impurity of iron occurring in commercial pure metals would produce expansion on its own account which would mask any small expansion of the metal, but these experiments show no such expansion, and do not confirm the simple superposition theory. (*b*) The Maxwell strain $B^2/8\pi M$ cannot exist in the material rods tried, or it would have been easily detected, so we have fresh evidence that there is no mechanical connection, unless an extremely weak one, between matter and ether.

A note is appended to the paper in which Mr. G. A. Schott calculates the correction factor which must be applied to the ordinary expression for field $H=4\pi n\gamma$, when the field is taken over the whole length of the coil used.

Royal Society.—"The Maximum Order of an Irreducible Covariant of a System of Binary Forms." By A. **Young**. Communicated by Major P. A. MacMahon, D.Sc., F.R.S. Received September 26.

CAMBRIDGE.

Philosophical Society, October 26.—Dr. Baker, president, in the chair.—On nutrition and sex determination in man, by Mr. R. C. **Punnett**. Making use mainly of the London census of 1901, the author showed that if the various boroughs were divided into three groups of increasing poverty, the proportion of male to female births was least in the poorest and greatest in the wealthiest of these groups—in other words, the better the nutrition the greater the proportion of male births. It was shown, however, that there are certain factors, *e.g.* infant mortality, birth rate, and marriage age, which influence the above three groups unequally. When allowance is made for these factors it is likely that the proportion of the sexes produced in each group would be nearly identical, from which was inferred the improbability of different conditions of nutrition affecting sex determination in man.—Note on the action of radium rays and light on mercurous sulphate, by Mr. S. **Skinner**.—Note on the pulverisation of *nickel grains* in fuming nitric acid, by Dr. W. A. **Hollis**.—On the specific heat of gaseous carbon dioxide at high pressures under constant volume, by Mr. W. A. D. **Rudge**.—On some minerals from the Binnenthal, Switzerland, by Mr. R. H. **Solly**.—(1) The theory of the multiple gamma function; (2) the asymptotic expansion of integral functions of multiple linear sequence, by the Rev. E. W. **Barnes**.—The expression of the double zeta function and double gamma function in terms of elliptic functions, by Mr. G. H. **Hardy**.—On the kinetic theory of matter, by Mr. H. C. **Pocklington**.

PARIS.

Academy of Sciences, November 2.—M. Albert Gaudry in the chair.—On the non-regeneration of the spheridia in the sea-urchin, by M. Yves **Delage**. The experimental results described are in opposition to the hypothesis that the spheridia are the organs of equilibrium, since the removal of them does not permanently affect the powers of locomotion. Immediately after the removal of the spheridia the sea-urchins turn with more difficulty, but after some time it is impossible to distinguish them from others in this respect. This is not due to the regeneration of the spheridia, as there is no sign of them reappearing, three months after the operation.—Remarks on a communication of M. Raphael Dubois of October 19 last, by M. Edm. **Perrier**. Filippi was the first to state in 1852 that pearls were due to the presence of a parasite in the oyster, but his views were strongly contested. The results of the experiments of M. R. Dubois support this theory, and further confirmation is supplied from the laboratory of Rikitea.—Note by M. **Appell** on the second volume of his "Traité de Mécanique rationnelle."—On new effects produced by the *n*-rays; generalisation of the phenomena originally observed, by M. R. **Blondlot**. The *n*-rays are rays given off by various sources of light, capable of passing through an aluminium screen, and recognisable by their action upon a small electric spark or upon a feebly phosphorescent screen. It has now been found that these rays cause a slight but distinct increase in the luminosity of a feebly illuminated paper screen, and this effect is retained by the rays after reflection at a polished metallic surface.—On the virtual sugar of the blood, by MM. R. **Lépine** and **Boulud**. The carbohydrate present in the blood, measured by its reducing power and expressed as glucose, is frequently more abundant in the blood from the right ventricle than in arterial blood, and this contains more than blood from the veins.—The influence of mineral food upon the production of the sexes in diœceous plants, by M. Émile **Laurent**.—On left-handed

curves of constant torsion, by M. W. **de Tannenberg.**—On the determination of singular classes of Taylor's series, by M. Émile **Borel.**—On some points in the theory of *ensembles*, by M. Ernst **Lindelöf.**—On the relation between the pressure and the rate of chronometers, by M. Paul **Ditisheim.** It has been found that the variations in the rate are proportional to the differences in the pressure of the air. The action increases as the balance wheel is diminished, but tends towards a limit when the wheel is very small.—Remarks on the preceding paper, by M. Ch.-Éd. **Guillaume.** The effect produced would appear to be due to a small mass of air carried round with the balance wheel.—On the magnetic storm of October 31, by M. Th. **Moureaux.** The extreme amplitude of the variation is 0·0068 C.G.S. units for the horizontal component, and 0·0052 for the vertical component, numbers corresponding to 1/29 and 1/81 of the absolute values of these components.—On a variety of filiform carbon, by MM. **Constant** and Henri **Pélabon.** This form of carbon is formed from heavy hydrocarbons by the action of a very high temperature. It is attacked by fuming nitric acid and potassium chlorate.—On the separation and estimation of iron and phosphoric acid in water, by M. H. **Causse.**—On a method of synthesis of symmetrical dihalogen derivatives of benzophenone, by M. F. **Bodroux.** *p*-Dibromo-benzene treated with magnesium in the presence of dry ether gives $BrC_6H_4.Mg.Br$, and this with carbon dioxide gives a substituted benzoic acid and a ketone. Further examination of the latter has shown it to be symmetrical di-*p*-bromophenyl-ketone. At a very low temperature the acid is the chief product, the proportion of ketone produced increasing with the temperature.—The application of pyridine to the preparation of some amides, by M. P. **Freundler.**—On the use of magnesium amalgam in organic chemistry, by M. Louis **Meunier.** Details of the preparation of diphenylmethane and ethyl derivatives of malonic esters are given.—On orthotoluic aldehyde, by M. H. **Fournier.** This aldehyde is prepared in the pure state by the oxidation of the corresponding alcohol.—On the coagulation of starch, by MM. J. **Wolf** and A. **Fernbach.**—The olfactory sense of the snail (*Helix pomatia*), by M. Émile **Yung.** The sense of smell is, as a rule, limited to a distance of 2 to 3 cm.—The osmotic regulation of the internal liquids in Echinoderms, by MM. Victor **Henri** and S. **Lalou.** The results show that all the membranes which separate the internal fluids of the sea-urchins from the external liquid are semi-permeable.—On the fatty materials and the acidity of flour, by M. **Balland.**

DIARY OF SOCIETIES.

THURSDAY, NOVEMBER 12.

MATHEMATICAL SOCIETY, at 5.30.—Annual General Meeting.—On Sequences of Sets of Intervals containing a Given Set of Points: W. H. Young.—On Spherical Curves: H. Hilton.—On the Weddle Quartic Surface: Dr. H. F. Baker.—A Formal Generalisation of Maclaurin's Theorem: Rev. F. H. Jackson. Diffraction: W. H. Jackson.—A General Theorem concerning Absolutely Convergent Series: G. H. Hardy.—Note on Borgnet's Method of Dividing an Angle in an Arbitrary Ratio: Prof. J. D. Everett.—On an Expression of the Electromagnetic Field by Means of Two Scalar Potential Functions: E. T. Whittaker.—The Propagation of Wave-motion in an Isotropic Elastic Solid Medium: Prof. A. E. H. Love. Notes on Quaternions, including a Simple Construction for $V\alpha\beta\gamma$: Prof. R. W. Genese.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Inaugural Address by the President, Mr. Robert Kaye Gray.

FRIDAY, NOVEMBER 13.

PHYSICAL SOCIETY, at 8. (1) Means for Electrifying the Atmosphere on a Large Scale: (2) an Arrangement for driving Mercury Pumps: Sir Oliver J. Lodge and Benjamin Davies.

ROYAL ASTRONOMICAL SOCIETY, at 5.—Observations of Mars in 1903: Rev. T. E. R. Phillips.—Observations of Variable Stars; edited by H. H. Turner: Sir C. E. Peek (the late).—Ephemeris for Physical Observations of the Moon, 1904: A. C. D. Crommelin.—Results of Double Star Measures, 1902: J. Tebbutt.—Systematic Proper Motions of Bright Stars relatively to Faint Stars in the Oxford Zones (+25° to +31°): H. H. Turner.—Measures of Southern Double Stars, 1902–3: J. L. Scott.—Observations of Borrelly's Comet (*c* 1903): Natal Observatory.—Remarks on a Paper by Mr. Cooke on a New Method of Determining Time, Latitude and Azimuth: E. B. H. Wade.—Preliminary Note on the Effect of the Direction of Gravity on Lunar Observations: E. B. H. Wade.—A Spectrographic Study of β Libræ: Rev. W. Sidgreaves.—Observations of White Spots on Saturn: A. S. Williams.—*Promised Papers*:—Note on a Method of Photographing the Moon and surrounding Stars: H. H. Turner.—Errors in the Moon's Tabular Longitude from 1750: P. H. Cowell.—On the Large Sun-spots of 1903 October and November, and Associated Magnetic Disturbances. Communicated by the Astronomer Royal: Royal Observatory, Greenwich.—Note on Photographs of Comet *c* 1903 (Borrelly). Communicated by the Astronomer Royal: Royal Observatory, Greenwich.

TUESDAY, NOVEMBER 17.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Discussion of Paper on Tensile Tests of Mild Steel, and the Relation of Elongation to the Size of the Test-bar: Prof. W. C. Unwin, F.R.S.

ZOOLOGICAL SOCIETY, at 8.30.—Note upon the Tongue and Windpipe of the American Vultures, with Remarks on the Inter-relations of the Genera Sarcorhamphus, Gypagus and Cathartes: F. E. Beddard, F.R.S.—On the Mammals of Cyprus: Miss Dorothy M. A. Bate.—Report on the Fishes collected by Mr. Oscar Neumann and Baron Carlo von Erlanger in Gallaland and Southern Ethiopia: G. A. Boulenger, F.R.S.

ROYAL STATISTICAL SOCIETY, at 5.30.—Annual Presidential Address: Major Patrick G. Craigie, C.B.

MINERALOGICAL SOCIETY, at 8.—On Sartorite, Anatase, Galena and other Minerals from the Binnenthal: R. H. Solly.—On the Pleochroism of Adamite: L. J. Spencer.

WEDNESDAY, NOVEMBER 18.

CHEMICAL SOCIETY, at 5.30.—Constitution of Ethyl Cyanacetate. Condensation of Ethyl Cyanacetate with its Enolic Form: P. Remfry and J. F. Thorpe.—The Action of Water and Dilute Caustic Soda Solutions on Crystalline and Amorphous Arsenic: W. T. Cooke.—The Union of Carbon Monoxide and Oxygen, and the Drying of Gases by Cooling: A. F. Girvan.—Note on a Double Chloride of Molybdenum and Potassium: G. G. Henderson.—Simplification of Zeisel's Method for the Determination of Methoxy- and Ethoxy-Groups: W. H. Perkin, Senr.—The Action of Benzamidine on Olefine β-Diketones: S. Ruhemann.

GEOLOGICAL SOCIETY, at 8.—On the Occurrence of Edestus in the Coal-measures of Britain: E. T. Newton, F.R.S.—Notes on some Upper Jurassic Ammonites, with special reference to Specimens in the University Museum, Oxford: Miss Maud Healey.

SOCIETY OF ARTS, at 8.—Opening Address of the 150th Session: Sir William Abney, K.C.B., F.R.S., Vice-President and Chairman of the Council.

ENTOMOLOGICAL SOCIETY, at 8.

ROYAL METEOROLOGICAL SOCIETY, at 7.30.—The Great Dustfall of February 21 and 22, 1903, and its Origin: Dr. Hugh Robert Mill and R. G. K. Lempfert.

ROYAL MICROSCOPICAL SOCIETY, at 8.—Miscroscopic Resolution: Prof. J. D. Everett, F.R.S.—The Mouth Parts in the Nemocera and their Relation to the other Families in Diptera: Walter Wesché.

THURSDAY, NOVEMBER 19.

ROYAL SOCIETY, at 4.30.—The Physiological Action and Antidotes of Colubrine and Viperine Snake Venoms: Dr. L. Rogers.—The Cell Structure of the Cyanophyceæ: H. Wager.—On the Rapidity of the Nervous Impulse in Tall and Short Individuals: Dr. N. H. Alcock.—Electrometer Records of Secreto-motor Changes: Dr. A. D. Waller, F.R.S.—On the Nematocysts of Aeolids: G. H. Grosvenor.

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THURSDAY, NOVEMBER 19, 1903.

VEGETATION IN HERCYNIA.

Die Vegetation der Erde. vi. Der Hercynische Florenbezirk. Von Dr. Oscar Drude. Pp. xix + 671; mit 5 Vollbildern, 16 Textfiguren, und 1 Karte. (Leipzig: W. Engelmann.) Price 30 marks; Subscription price 20 marks.

THIS work is an elaborate monograph on the distribution of the vegetation in the Hercynian district of Germany, and forms the sixth volume in Drs. Engler and Drude's series "Die Vegetation der Erde." Dr. Oscar Drude, the author, the professor of botany at Dresden, has long been an accepted authority on the various problems connected with plant geography. In his "Deutschlands Pflanzengeographie," published in 1895, he defined seven regions of vegetation in the German flora, and in the present work he deals much more exhaustively with the mountainous and hilly country which stretches from the Hartz to the Rhön, reaching to Lausitz on the east and to the Böhmer Walde. The botanical literature of the area with which he deals is extensive, as it has been known to botanists ever since the time of Valerius Cordus, who was born in 1515. In 1588 Johann Thal wrote his "Sylva Hercynia," which was a catalogue of the plants growing in that district, and in the same year Joachim Camerarius published a work containing some curious coloured figures of some of the plants.

Dr. Drude divides the various Hercynian "Formationen" or plant habitats into ten main groups; these he again subdivides, making in all thirty-two. He carefully traces the absence or presence of these through the fifteen subdivisions of his geographical area. It may be well to indicate briefly the character of these ten groups (with one or two examples of the predominant vegetation of each), as their discussion occupies much of the volume.

Group i.—Woods of the low country and hills reaching 500 metres. Predominant vegetation:—Fagus, Quercus, Carpinus. Accessory:—Ulmus, Tilia, &c. The first subdivision of this group contains many shrubs, Cornus, Caprifoliaceæ and Rosaceæ, and is specially prevalent in Hesse and South Hanover, Thuringia, and parts of Upper Saxony.

ii.—Woods within the inundation area of rivers, &c., upper limit about 500 metres. Alnus, Betula, *Populus tremula*, &c., while Fagus is absent. The first subdivision of this group is almost absent in the Hercynian highlands proper.

iii.—Woods from 1100–1360 metres. Fagus, *Acer Pseudo-platanus, Picea excelsa, Abies pectinata,* the latter species wanting in certain districts. This group, in all its subdivisions, predominates in the Hercynian highlands proper.

iv.—Sandy plains and heaths. Calluna, *Vaccinium Myrtillus,* and *V. Vitis Idaea.* Predominates in Hesse and South Hanover, Thuringia and Upper Saxony, but present to a very small extent in the Hercynian highlands.

v.—Sunny hill formation. Carpinus, Tilia, and *Quercus sessiliflora,* species of Teucrium, Thymus, Helianthemum, and Dianthus. The first three subdivisions of this group predominate in Hesse, South Hanover, Thuringia, and Upper Saxony, but with slight exception are absent in the Hercynian highlands.

vi.—Wet meadows, &c. Hydrophilous, Poæ, Cyperaceæ, and Juncaceæ.

The first subdivision of this group contains Dactylis, Phleum, *Avena elatior, Festuca elatior* and *arundinacea*, and occurs in all the subdivisions of the geographical area with the exception of the Bohemian forests.

vii.—Turf moors. Hydrocotyle, Rhynchospora, and *Gentiana Pneumonanthe.* Hill turf moors are absent in Thuringia and Upper Saxony.

viii.—Subalpine Hercynian hill formation, 900–1450 metres. *Lycopodium alpinum* and *L. Selago,* also *Empetrum nigrum.* The two subdivisions of this group predominate in the Hartz Mountains, in the Erz, and in the Bohemian Forest.

ix.—Inland watery situations. Nymphæa, Hydrocharis, Typha, Heleocharis, and Littorella. The first three subdivisions of this group predominate in Hesse, South Hanover, Upper Saxony, and to some extent are present in the Hercynian highlands. The last subdivision of the group, saltmarshes, &c., of which the characteristic vegetation is *Aster Tripolium, Triglochin maritimum*, Salicornia, *Obione pedunculata,* &c., is present in Hesse, South Hanover, Thuringia, but absent in Upper Saxony and the Hercynian highlands.

x.—Cultivated ground. Chenopodiaceæ, Solanaceæ, *Centaurea Cyanus, Agrostemma Githago,* and *Neslia paniculata.* Present in all the subdivisions of the area except the Bohemian forest.

The flora of Hercynia does not differ very materially from that of Britain, and nearly all the plants are lound in similar situations in this country, so the volume is well worth the attention of our own local ecologists.

Fifteen chapters of the book are devoted to various portions of the geographical area, as, for instance, Das Weser Bergland, Das Braunschweiger Hügelland, and Hügelland der Werra and Fulda mit der Rhön, &c., and under each are discussed their orographic and geognostic character—the formations that occur in the area and the topography. Perhaps one of the most interesting of these chapters is that on the Hartz Mountains.

The Hartz is a detached chain, flat on the top, 2000 feet above the sea, with a number of peaks rising out of this, among which the Brocken, 3733 feet above the sea, is the highest. Its geological composition is granite. On p. 497 we have a figure showing the character of the vegetation surrounding the summit. The Weser Mountains are lower, averaging not more than 600 feet, the highest point being 1500 feet. The Rhöngebirge and several basaltic ridges are also low.

Many years ago it was pointed out that the Hartz Mountains present some curious peculiarities in their vegetation which deserve especial notice. In order to comprehend them in their true independence, we must

exclude the low promontories and ranges of hills around the great mass, since the vegetation of these, both geologically and botanically, agrees with those of the terraces of the Elbe and the Weser. The uniformity of structure of the great central mass of the Hartz, the rarity of lime, &c., causes a comparative poverty of peculiar forms of flowering plants, but, on the other hand, a subalpine character may be detected, and this at a height above the sea which would not lead one to expect it. Another feature, long ago pointed out, is the depression of the climatic tree-limit. Dr. Drude gives the following list of the twenty-four rarer or characteristic species of the Brocken flora :—*Listera cordata, Epipogon aphyllus, Trichophorum caespitosum, T. alpinum, Carex pauciflora, ? C. Heleonastes, C. rigida, C. limosa, C. sparsiflora, Geum montanum, Linnaea borealis, Hieracium alpinum, H. nigrescens bructerum, Andromeda poliflora, ? Pinguicula alpina, Pulsatilla alpina, Empetrum nigrum, Rumex arifolius, Thesium alpinum, Salix bicolor, Betula nana, Lycopodium alpinum, Selaginella spinulosa,* and *Athyrium alpestre.*

Saxifraga Hirculus was found by Kohl in the neighbourhood of Zorge in 1809, but does not seem to have been gathered by anyone since that date, and many other interesting notes on individual species are given.

Hampe, in his "Flora Hercynica," gives 1343 vascular plants as occurring within his area, and there is a good deal of additional information on the distribution of plants in this region in A. Andree's little pamphlet "Die Flora des Hartzes und des Östlichen Vorlandes bis zur Saale."

The Erzgebirge, a chain of mountains mostly of primary formation, are on the south-east of the area taken by Dr. Drude. A long list of the characteristic species is given, from which we select the following as particularly worthy of note :—*Orchis globosa, Herminium Monorchis, Coeloglossum viride, Gymnadenia albida, Listera cordata, Corallorhiza innata, Lilium bulbiferum, Streptopus amplexifolius, Polygonatum verticillatum, Luzula silvatica, L. sudetica, Trichophorum caespitosum, Carex pauciflora, C. rigida, C. supina, C. limosa, Calamagrostis montana, Poa sudetica, Scheuchzeria palustris,* &c.

Meum athamanticum, Orchis globosa, Gentiana spathulata, and *Phyteuma orbiculare,* which are present in the Erzgebirge, are wanting in the Upper Böhmer Walde, and only the Meum and the Phyteuma reach the Hartz. *Senecio crispatus,* in the Thuringen Wald, reaches its northern limit in Hercynia, but it is impossible in a brief notice to give any idea of the mass of detailed information which Dr. Drude has here collected together.

Much good work has recently been published on the distribution of plants in various portions of the globe. In Central Europe there have been the preceding volumes in the present series, Prof. Moritz Willkomm's "Iberian Peninsula," Dr. Pax's admirable work on the Carpathians, Dr. Gustav Radde on the Caucasus, Dr. Beck on the various countries included under Illyria, and Dr. P. Graebner on north Germany. In the United States we have had Prof. MacMillan's "Minnesota Plant Life," "The Plant Life of Alabama" by Dr. Möhr, and a report on the Dismal Swamp region by Mr. Thomas H. Kearney. In this country the late Robert Smith mapped out three districts in Scotland, and his brother, Dr. W. G. Smith, of Leeds, and his colleagues have already mapped out two districts in Yorkshire, and given lists, illustrated by photographs, of the characteristic plants of the different stations. A first instalment of a botanical survey of the basins of the rivers Eden, Tees, Tyne and Wear, by Mr. F. J. Lewis, was lately read at the British Association, and we hope the contemplated survey of the Pennines, from Derbyshire to the Cheviots, will be successfully carried out.

Dr. Drude in Hercynia has done his work most fully and conscientiously. Every possible plant-association connected with every varying physical condition of the country has been carefully noted, and both its phenogamous and cryptogamous constituents have been determined. But we feel that the work may somewhat bewilder the ordinary reader by reason of its excessive elaboration. E. G. B.

MEASUREMENT BY LIGHT WAVES.

Light Waves and their Uses. By A. A. Michelson. The Decennial Publications of the University of Chicago. Pp. 166. (Chicago: University Press, 1903.) Price 2 dollars net.

THE University of Chicago, in commemoration of the completion of the first ten years of its existence, is publishing a series of volumes dedicated "to the men and women of our time and country who by wise and generous giving have encouraged the search after truth in all departments of knowledge."

The publication committee is to be congratulated in that it has persuaded Prof. Michelson to contribute a volume to this series. Anything that he writes is sure to be worth careful and attentive study, and while the actual scientific results recorded do not, as a rule, in any way claim to be new, Prof. Michelson has succeeded in putting the important consequences of his own inimitable work in a manner which will render them known to many who could hardly be expected to follow the original papers.

The volume contains eight lectures delivered at the Lowell Institute in 1899. It starts with an elementary account of light waves and their properties, and in the first lecture some of the consequences of the principle of interference are skilfully developed.

But the distinctive tone of the work is not noticeable until we come to Lecture ii., which deals with a comparison of the microscope and telescope with the interferometer.

An account is given of the action of a lens, and the theory of the diffraction fringes formed by a microscope or telescope objective is outlined. This leads to the theory of the resolving power of a microscope, and to the conclusion that, while 1/250 of an inch is the limit of resolution for the human eye, that of the microscope is one four-hundredth of this, or about one hundred-thousandth of an inch. It is then shown that by limiting the aperture of a telescope to two parallel slits near the opposite ends of a diameter, the fringes formed become more distinct, though with a considerable loss of light, and from this the action of various

forms of interferometer in which the interfering pencils are separated and then reunited after reflections at a series of plane mirrors is deduced. It is explained, further, that with such instruments the accuracy of measurement possible with a telescope or microscope can be greatly exceeded, and that, too, without serious loss of light.

The application of interference methods to various measurements forms the subject of the remaining lectures.

One of the features of the Edinburgh meeting of the British Association in 1892 was Michelson's paper on the application of interference methods to spectroscopic research read before Section A and printed in full among the reports.

Fizeau had years before explained the gradual disappearance and reappearance of Newton's rings when formed by sodium light between a flat surface and a lens of small curvature as the distance between the two is increased. It is due to the fact that the D line is double; the ring system seen, therefore, is a complex one produced by the superposition of the two systems due to each line separately. When the bright rings of the two systems coincide, the visibility of the rings is a maximum; as the distance between the lens and plate is increased, the bright rings of the first system overlap the dark rings of the second, the intensity of the field becomes uniform, and the rings cease to be visible.

Michelson defined the visibility of the ring system and showed how it depends on the distribution of light in the source; he then proceeded to measure experimentally the visibility of the rings formed by various spectrum lines, and from this to analyse the distribution of light in the lines. By a stroke of genius he utilised the defects of the ring system to advance our knowledge to a surprising extent. Lecture iv. contains a most interesting account of his work.

The chapters that follow are no less fascinating; thus the next lecture describes the measurements undertaken by Michelson at the Bureau International des Poids et Mesures at Sèvres to determine the relation between the wave-length of cadmium light and the standard metre; cadmium light was chosen because of the simplicity of the lines of its spectrum, and it was shown that in air at 15° C. and at normal pressure the number of waves in a metre is for the red ray of cadmium 1553163·5, for the green ray 1966249·7, and for the blue 2083372·1. The absolute accuracy of these results is said to be about one part in two millions, the relative accuracy about one part in twenty millions.

In Lecture vii., application of interference methods to astronomy, it is shown how an examination of the visibility curve of a star enables the observer to detect double stars which are far too close to be resolved by any telescope, while the last lecture, on the ether, deals with a problem which is yet unsolved, the theory of aberration.

The aberration constant, the ratio of the velocity of the earth to that of light, is a quantity of the order 1/10000, and its accurate measurement had proved no easy task. Michelson, with the view of solving the question whether the earth is at rest or in motion relative to the ether at its surface, undertook a measurement which involved the square of this tiny quantity, or one part in one hundred millions, and carried it out successfully. The result of the experiment was to show that this relative motion, if it exists at all, must be extremely small, and that the ordinary explanation of aberration, which assumes that the ether remains at rest while the earth moves through it without disturbing it, is untenable. The only solution of the difficulty yet offered is that due to Lorentz and Fitzgerald, who pointed out, independently, that the motion of a body through the ether might, on certain assumptions as to the connection between ether and matter, cause the body to contract in the direction of motion, and that this contraction would depend on the square of the aberration constant, so that its effect might compensate for the effect looked for by Michelson.

In his first lecture the author apologises for using, as illustrations of his subject, his own researches.

"I do this," he says, "because I believe I shall be much more likely to interest you by telling what I know than by repeating what someone else knows."

Prof. Michelson has earned our thanks for putting some of his knowledge into so attractive a form; he will perhaps forgive us if, in closing, we express the wish that he will tell us more of what he knows.

R. T. G.

ALL ABOUT CATS.

The Book of the Cat. By Miss F. Simpson. Pp. viii+380; illustrated. (London: Cassell and Co., Ltd., 1903.) Price 15*s.* net.

THE "cult of the cat" has of late years increased to such an enormous extent that there can be no doubt as to the need for a thoroughly trustworthy and exhaustive account of the various breeds kept in this country, together with notices of those of other lands. Of this favourable opportunity Miss Simpson has taken full advantage in the handsome and beautifully illustrated volume before us, the exceedingly low price of which places it within reach of fanciers in all ranks of life. In addition to the description of the various breeds kept in this country, the author has also given chapters on the feeding, housing, and general treatment of cats (derived from her own extensive experience), as well as on the management of cat-shows; while other chapters by various specialists are devoted to foreign breeds, the cat's place in nature, and the diseases of cats and their treatment. The book is therefore a compendium of all that relates to domesticated cats, and it may be almost said that it contains practically all that is worth knowing about these animals.

Perhaps the least satisfactory portion of the book, so far as Miss Simpson is concerned, is to be found in the opening lines of the first chapter, where we find the statement that the origin of the cat has long puzzled the learned, and is still a zoological mystery. Neither does the second sentence—"Historians tell us that the feline race came into existence about the same

time as the horse"—tend in any way to mend matters. Moreover, when we turn to the chapter on some foreign cats, by Mr. H. C. Brooke, we find it stated, although somewhat guardedly, that the Egyptian cat is the probable ancestor of our domesticated breeds. There does not, therefore, seem to be complete accord in this respect between the two authors, and we venture to suggest that, although the pedigree of the original British breed of cat cannot be fully traced, the term "mystery" is scarcely appropriate to the real facts of the case. In this connection mention may be made of Mr. Brooke's error in referring (p. 297) to the European and Egyptian wild cats as "varieties" instead of "species." It is perfectly true that the mistake, in analogous cases, is very frequently made by amateur zoologists, but it is nevertheless quite inexcusable.

Passing over the chapters devoted to the housing and exhibition of cats, our attention may be directed to what Miss Simpson has to say with regard to the various breeds kept in this country. The first group taken into consideration is that of the long-haired or Persian breeds, of which quite a number of different strains, chiefly or entirely distinguished by colour, are recognised by fanciers. The author is of opinion that no satisfactory distinction can be drawn between Angora and Persian cats, and in this she is doubtless right. No reference is, however, made to the opinion current among zoologists that the Persians very probably trace their origin to the long-haired Pallas's cat (*Felis manul*) of Central Asia, which, with the exception of the tail and limbs, is a nearly uniformly coloured species. Neither is enough made of the fact that all imported Persians appear to be uniformly coloured, although a quotation from Mr. Harrison Weir to this effect is given. If this be really the case, there can be no doubt that all Persians with "tabby" and "tortoise-shell" markings are due to a cross between the pure breed and European cats. Strong confirmation of this is afforded by a statement of the author to the effect that so-called orange Persians tend to lose their markings and become uniformly coloured.

Under the heading of Manx cats the author alludes to the current belief that these are due to a cross between a cat and a rabbit! A whole chapter is devoted to the beautiful Siamese cat, although no reference is made to its possible origin from the bay cat (*F. badia*). To the author's account of ordinary short-haired cats we need not refer, and the remaining space at our disposal must be devoted to foreign cats (other than those kept in this country). Mr. Brooke, in chapter xxvi., has been fortunate in securing some very interesting photographs, notably those of the Burmese and Abyssinian breeds, the latter of which is also represented in a coloured plate, together with an Indian cat. Most remarkable of all is, however, the photograph of hairless New Mexican cats, now said to be all but, if not quite, extinct.

Although the book might have been improved if the proofs had been submitted to a zoologist, there can be little hesitation in pronouncing it a decided success, and indispensable to every student and breeder of cats.

R. L.

AMERICAN RAILWAYS.

American Railways. By Edwin A. Pratt. Pp. viii+309. (London: Macmillan and Co., Ltd., 1903.) Price 3*s*. 6*d*. net.

AS it appears to be the fashion just now to look upon British railroad management as antiquated, and its methods effete, it is interesting to study a book dealing with American practice, as its adoption in this country is looked upon by some as the only salvation of British railways from a dividend earning point of view.

The volume before us deals with the general question in a fair and open manner. Mr. Pratt evidently went to the States with the intention of seeing as much as possible, and comparing what he did see with home practice; he gives us in his book a very readable account of the result.

The big waggon question is, of course, interesting, and we read that twenty-five years ago the average freight box waggon in the United States had a capacity ranging from 16,000 lb. to 24,000 lb. Then, in 1881, the 40,000 lb. waggon was introduced, this being followed in 1885 by the 60,000 lb. waggon. After this, in 1898, a waggon, though no larger than its predecessors, was so constructed as to have a capacity of 80,000 lb., and to-day waggons are being extensively used with a capacity of 100,000 lb. This continual increase in waggon capacity is well illustrated by means of tables. The dead weight is gradually being reduced, and in the case of pressed steel waggons the proportion of paying weight to the total weight of the car when loaded is 73 per cent., and it is interesting to know that waggons of this type are being gradually introduced into this country, the most satisfactory being those designed and made by the Leeds Forge Company.

With the rapid increase in the weight of trains hauled came the heavier and more powerful locomotive, and it is here where the American locomotive engineer has the advantage of his British brother, it being possible for the American engine to be both higher and wider than the British engine, thus materially increasing its capacity.

We read that the majority of American officials with whom the author discussed the big waggon question did not care to commit themselves to any recommendation of the use of such large waggons in Great Britain. The nearest approach is the American type of enlarged freight waggon for the transport of coal from the collieries to the sea, and these are now being successfully used by the North-Eastern Railway.

An important conversation with a prominent official is reported on the general question of handling of traffic in the two countries. He said, ours is wholesale business, yours is retail. We get bigger lots than you do, and we can handle them to better advantage; but in regard to general merchandise your arrangements are far better than ours, &c. It is evident, therefore, that the conditions are so very different that the mere adoption of American methods *en bloc* is not sufficient in itself. No doubt there are many practices which can be assimilated with advantage, and these can only be discovered and thought out by sending

picked railway men on a tour of inspection over the American railways.

Chapter xx. is of value. The author gives us the benefit of his "conclusions," and states that

"before starting on my tour of the United States I had heard or read so much in praise of the conditions existing on American railways that I expected to bring back with me a long list of recommendations deserving consideration on this side. But the more I looked for and inquired after any special advantages that were really suited to British conditions, and desirable of adoption here. the greater my difficulty in finding or learning of any became."

There is no doubt, however, that the British railways are only too anxious to learn, for most of the important lines have sent their officials to study on the spot and to investigate anything that is new.

We can recommend this book to all students of railway practice as one containing much useful information and decidedly worth reading. N. J. L.

OUR BOOK SHELF.

Why the Mind has a Body. By C. A. Strong. Pp. x+355. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1903.) Price 10s. 6d net.

IN this book Prof. Strong deals with the riddle of the universe, and contributes some original ideas toward its solution. Of the three sections into which the work is divided, the first deals with the current theories of automatism, parallelism, and interaction, and criticises them on their merits; the second gives us a metaphysical ground-work; the third resumes criticism on the bases of the results of the second part, and develops the new doctrine. The critical part must be left to the reader, who will not fail to find it vigorous and interesting; as the peculiar features of the author's thought emerge most clearly in the constructive work, our space will be best used in indicating these ideas.

The goal is psychophysical idealism, which is metaphysically monistic, but distinct from psychophysical monism. The world, as we then have it, is monistic in "stuff" and in "form"; in form, for the theory "conceives individual minds and other things-in-themselves as together constituting a single system"; in stuff, for all is mental. This conclusion rests on the doctrine of things-in-themselves which the second section is designed to prove. As to these, the nature of reality is known to us in consciousness; they are therefore not unknowable; we also have a transcendent knowledge of other minds, hence we know some extra-mental realities, and are saved from solipsism. Two such realities may stand in a causal relation each to each; Kant's limitation of causality to the sphere of experience applies only to phenomenal causality; but there is also a real causality to which this limitation does not apply which may be used to transcend experience. If we now ask how the causal chain, *e.g.* from A's anger to B's sensation of pain, is to be constructed, we find a gap which requires filling; hence a "cosmological proof" of other things-in-themselves which must be mental but are not consciousnesses.

It must be left to the reader to follow these arguments in detail; the bare outline here given will serve to show the trend of thought; the whole is not unworthy of the slightly paradoxical title. The author is always attractive, and his style is vigorous, though at times Transatlantic in diction; he anticipates the possibility of failing to convince his readers, in which he is not without justification, for he deals with the obscure obscurely. The most fundamental and most difficult point is the relation of one consciousness to another; here we have a "transcendent" knowledge hitherto overlooked by philosophers. This knowledge is founded "neither on reason nor experience, but solely on instinct" (p. 219). Deeper still, our own past experience stands to us in the same relation as another consciousness; "it literally *is* another consciousness, though one no longer existent" (p. 222). We reach this by a conjecture which bears "the closest analogy to the process by which we infer other minds" (p. 222). Then is our "instinct" after all an inference? And if we know another consciousness because it in some way acts upon us, do our own past experiences also in some way act upon us? As this is not a criticism, the question may be left without discussion. What should be noted is that, though we find the self-development of mind rejected, the evolution of things-in-themselves accepted, though we hear of the "imprinting" achieved by things upon minds (which seems convertible with evoking states of consciousness), we nowhere have a discussion of the problem of activity; that is why our gratitude for this work does not obliterate the feeling that one riddle has been solved by—another. G. S. B.

The Position of the Old Red Sandstone in the Geological Succession. By A. G. M. Thomson, F.G.S. Pp. vi + 224. (Dundee: John Leng and Co., 1903.)

MORE than sixty years ago Hugh Miller, in his classic on "The Old Red Sandstone," remarked, "There are some of our British geologists, too, who still regard it as a sort of debatable tract, entitled to no independent status. They find, in what they deem its upper beds, the fossils of the Coal Measures (*i.e.* Lower Carboniferous), and the lower graduating apparently into the Silurian System; and regard the whole as a sort of common, which should be divided as proprietors used to divide commons in Scotland half a century ago, by giving a portion to each of the bordering territories." One object of the present work is to show that the conditions under which the Old Red Sandstone was produced may not have been of the character of inland lakes without free connection with the sea; and another object is to show that these conditions may not have begun only after the close of those which produced the highest Silurian strata, nor have terminated before the date of deposition of the oldest of the Carboniferous beds.

It would seem as if we had made very little progress during the past sixty years, and, to a certain extent, this is true. The ancient physical geography of the Old Red Sandstone period has yet to be clearly depicted, and the precise relations of Old Red Sandstone and Devonian to Silurian and Carboniferous still require further detailed research among the fossil plants and animals, and among the rocks in which these organic remains are entombed. A book should in this, as in all other cases, be either useful or interesting, or it might, as with Hugh Miller's works, possess both attributes. The present work, however, seems to fail in both respects. The expressions used by the author, of "Prevertebrate" and "Vertebrate Silurian," "Prevertebrate" and "Vertebrate Old Red," eleven times on one page, and often six or seven times, and in one instance varied by the printer into "Pervertebrate," are, to say the least of it, tiresome. We read also of "Vertebrate Palæozoic times" and "'Vertebrate Old Red' rivers."

The work is mainly a discussion with regard to the distribution and succession of life, and with regard to the physical conditions, bearing on the objects previously expressed. It may afford some new suggestions to those studying the Old Red Sandstone, but it lacks precise stratigraphical evidence and tabula-

tion of facts. Too many sentences commence with "Suppose," or "It would not be surprising," or "It is just possible," or words with a like significance. If the author had put his views into an essay of ten or twelve pages, he would have done more to further his object, in which we cordially sympathise, of arriving "at the truth concerning the position of the Old Red in the succession."

Steel and Iron for Advanced Students. By Arthur H. Hiorns. Pp. xvi + 514. (London: Macmillan and Co., Ltd., 1903.) Price 10*s*. 6*d*.

EVIDENTLY based upon a course of lectures delivered at the Birmingham Municipal Technical School, this little book is primarily a text-book not of so highly advanced a character as the title might perhaps suggest. It is well up to date, and embodies the latest views on the subject expressed at recent meetings of the Iron and Steel Institute. The arrangement of the matter is very similar to that adopted in Bauerman's "Metallurgy of Iron" and in Greenwood's "Steel and Iron." The 131 illustrations are admirable, and well adapted to indicate to the student or intelligent workman the principles described. The index is the least satisfactory part of the book. The names of several authors cited (Brinell, Brustlein, Carvès, Chênot, Eyermann, Hoffmann, Lürmann, Massicks and Crooke, Mukai, McWilliam and Pourcel) are incorrectly spelt, whilst several authors to whom reference is made in the text (Berthier, Chernoff, Ewing, Faraday, Galbraith, Hautefeuille, and Wingham) are omitted. Similar errors in proper names occur in the text. Sir Lowthian Bell, for example, is described as Sir Lothian (p. 135) and as Mr. Bell (p. 380), and no distinction is made between Mr. Edward Riley and Mr. James Riley. Despite these faults, the book may be cordially recommended to science teachers as one which is eminently suitable for metallurgical classes.

Agriculture for Beginners. By C. W. Burkett, F. L. Stevens, and D. H. Hill. Pp. xii+267. (Boston and London: Ginn and Co., 1903.)

THE question of the introduction of instruction in agriculture or any other definitely technical subject into our elementary schools is one which has been much debated recently, but the opinion of most of those who have any working knowledge of teaching is very strongly against it. Agriculture in schools is very likely to become a book subject; it is far preferable to take up some question like the growth of a plant, which admits both of simple experiment on the part of the pupil and of abundant illustration from practical life, which again supplies a basis of reasoning and knowledge for anyone who happens in later life to be concerned in the raising of crops.

The authors, however, of the little book under notice consider that in the country schools of the United States something more definitely agricultural is wanted, since "most boys and girls reared on a farm get no educational training except that given in the public schools." They have, accordingly, prepared a text-book which, in the earlier stages, deals with the plant in the manner we have indicated, by simple experiments capable of repetition by the scholars. They pass on to more special topics, such as cross-fertilisation and the raising of new varieties, diseases of plants, insect pests, crops and stock, dairying, &c., all treated in a simple and attractive fashion, with a great wealth of illustrations, admirably selected and reproduced. The conditions dealt with are, however, so distinctively American as to render the book of little service in English schools, though the teacher himself may obtain from it some hints as to method and many excellent illustrations.

The Praxis of Urinary Analysis. A Guide to the Chemical Analysis of Urine. By Dr. Lassar-Cohn, Professor in the University of Koenigsberg. Authorised Translation by H. W. F. Lorenz, A.M., Ph.D. Pp. vi+58. (New York: John Wiley and Sons; London: Chapman and Hall, Ltd., 1903.) Price 1 dollar.

THE object of this little book is stated to be to give directions for the chemical determinations of the *ordinary* constituents of urine and of the stomach contents that are of value for diagnosis. Even with this limitation, the directions given are too brief, especially as regards those for quantitative estimations. For the detection of albumen the heat test, and for sugar Trommer's test, alone are mentioned. For the quantitative estimation of sugar, it is stated that titration with Fehling's solution is only suitable for chemical laboratories, because the solution must be freshly prepared, and, "secondly, and this is much more annoying, it is extremely difficult to determine the end of the reaction, for solutions of the proper strength can be bought nowadays" (p. 38). The translation must have gone astray here. As regards practical value, the two pages upon the quantitative estimation of sugar might have been omitted.

R. T. HEWLETT.

Studies in Physiology, Anatomy and Hygiene. By J. E. Peabody, A.M., Instructor in Biology in the Morris High School, New York City. Pp. xviii + 332; 147 illustrations in the text. (New York: the Macmillan Co.; London: Macmillan and Co., Ltd., 1903.) Price 5*s*. net.

THIS is one of a numerous class of books suitable for use in high schools and similar institutions. As its title implies, it gives, in addition to the principles of physiology, as much anatomy and also, it may be mentioned, chemistry as is necessary for the understanding of the bodily functions; the application of such knowledge to everyday life (hygiene) is also pointed out in a sensible and practical way. A book of this character does not call for any lengthy review; it is sufficient to say that after a careful perusal we are convinced that it will fulfil the *rôle* the author wishes it to play. It is clearly written, well illustrated, and, what is more important, is unusually free from errors.

Arithmetic. Part ii. By H. G. Willis, M.A. Pp. viii + 236 + xxxix. (London: Rivingtons, 1903.) Price 1*s*. 4*d*.

THE senior mathematical master of Manchester Grammar School here continues his plan of supplying examples in arithmetic grouped in series so as to furnish two or three lessons a week for a term. These exercises cover the parts of the subject studied in schools which were not dealt with in the author's former book. Oral questions are inserted at the beginning of each exercise, and answers to all examples are provided.

Arithmetical Types and Examples. By W. G. Borchardt, M.A., B.Sc. Pp. xii + 367. (London: Rivingtons, 1903.) Price 3*s*. 6*d*.

THIS volume is, the author states, intended to stand between the complete text-book of arithmetic and the mere compilation of examples. Each exercise is preceded by a model worked-out example, and a few explanatory notes are added. Most of the recommendations of the recent committee of the Mathematical Association have been adopted, and full answers are given. We notice that graphical methods are made use of, and logarithms are employed to facilitate the calculation of compound interest.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Heating Effect of the Radium Emanation.

A FORTNIGHT ago I wrote to you respecting the rise of temperature observed in radium compounds. I pointed out that the experiments of Profs. Rutherford and Barnes seemed to show that the effect was largely due to the excited activity. I have since then made a few experiments confirming that view.

Air charged with radium emanation was led through a tube in which I placed a thermal junction formed by iron and nickel wires. The junction was left charged to a high negative potential during about ten minutes, then taken out and placed side by side with an unexposed junction in a metal vessel kept at constant temperature by a water jacket. The two junctions at first seemed to be at the same temperature, but the exposed one began to become warmer almost immediately, and after twenty minutes was about one-tenth of a degree higher than the other junction. The experiment was repeated with the same result. Test experiments were made in various ways to show that accidental temperature disturbances could not affect the experiment. Thus, after the wire had been treated exactly in the same way in a current charged with thorium emanation, the junction showed absolutely no change of temperature detectable by the galvanometer used.

We may draw an important conclusion from these experiments. Prof. Rutherford has given strong evidence to show that the excited activity really contains three successive stages of radio-active matter, the first changing into the second, and the second into the third; the fact that the maximum heating effect was only obtained thirty minutes after the wire was first exposed to the emanation seems to show that it is the last transformation in which the third excited activity finally disappears or becomes inactive which sets the energy free. Experiments are now in progress to test the matter further.

The experiment mentioned above with the thorium emanation was not altogether satisfactory, and I should not at present like to draw the conclusion that the excited activity due to thorium does not give a heating effect. I only mention it here to show that the treatment of the wire in the experiment independently of the presence of radium does not give rise to such variations of temperature as have been observed. Had any appreciable amount of the heating effect been due to the contact with the emanation, I should have expected the junction to show some rise in temperature when first introduced to the calorimeter. All these results should be considered as provisional only until a more detailed investigation has been made.

ARTHUR SCHUSTER.

The Owens College, Manchester, November 14.

Radium and Animals.

IN the issue of NATURE of November 5, Mr. Dixon gave a brief account of some interesting experiments with radium upon seedlings and upon Volvox, the results of which were almost entirely negative. Like Mr. Dixon, I have been investigating the action of radium rays upon living matter, but in my experiments animals of simple structure have been employed instead of plants, and my experience leads me to think that the negative result of his experiments may have been due to the distance which separated the small quantity of radium he employed from the seedlings.

In my experiments, which I have been carrying out in the university physiological laboratory, three lots of radium bromide were used, 5 mgr., 10 mgr., and 50 mgr. respectively. These were brought within 3 mm. of the cells containing the animals, the walls of which were made of thin mica instead of glass in order to lessen the absorption of the rays.

It is too soon to discuss that obscure problem, the nature of the influence of the rays upon living matter, but it is already clear that experiments with simple forms of life will furnish some data.

I have endeavoured to determine (α) whether the rays would provoke an immediate response of the nature of a contraction; (β) whether they would evoke the more generalised "tactic" response—that is to say, whether they would repel or attract the animals. Put very briefly the results are as follows:—

(α) Actinosphærium, with pseudopodia extended, exposed in daylight to 10 mgr. radium at 3 mm. did not retract its pseudopodia. In two hours, however, it was dead and breaking up. Controls were unchanged.

Stentor—a green species. Two specimens were kept in the dark for some hours to increase their sensitiveness to radiant energy. On examination with a minimum of light the animals were found extended with cilia in rapid movement. Exposed to the rays from 50 mgr. of radium at 4 mm. both slowly contracted, and slowly extended on removal of the radium. This observation was repeated three times. After the third exposure one Stentor refused to extend.

(β) Stentor. Sixteen free-swimming specimens were placed in the dark in a cell over a lead plate 3 mm. thick with a hole in the centre about 5 mm. in diameter under which was 50 mgr. of radium bromide. Next day fifteen of the animals had attached themselves clear of the pencil of β rays, and one injured specimen was in the path of the rays.

The cell was then moved so that a group of five came into the path of the β rays. In a few hours these were found to have detached themselves and moved out of the rays.

Similar results were obtained on other occasions, though it seems possible for the rays to kill feeble specimens before they respond to the repelling influence.

Hydra, both *viridis* and *fusca*, will, as a rule, detach themselves and move out of a pencil of β rays. If, however, the animal is again moved back into the rays from 50 mgr. at 4 mm. distance the third immersion is usually fatal—the tentacles drop off and the body slowly breaks up.

Perhaps the most interesting result was obtained with *Euglena viridis*. Encysted specimens under the influence of radium rays (β and γ) in the dark readily become motile and disperse without suffering any harm.

Newnham College, Cambridge. E. G. WILLCOCK.

Note on the Arctic Fox (Canis lagopus).

A RATHER peculiar error in regard to this animal seems in danger of being perpetuated in certain contemporary literature, in which it is stated that, while in the other regions of its distribution the Arctic fox generally acquires a white winter coat, in Iceland this change never takes place, but that all the foxes there are blue. As a matter of fact, this fox turns white in the Icelandic winter as elsewhere, with this reservation only, that the proportion of blue winter forms there is greater than the proportion in the Arctic regions generally, the white forms, however, probably still remaining in an actual majority. I believe this occurrence of the white phase in Iceland is so far well known that I need not dwell on the evidence for it; from personal experience, however, I can corroborate it. It is a small point, but in so far as error is abroad, it seems advisable to correct it.

In Iceland I was informed that the white form and the blue were distinct, and in his work on this island a century and a half ago, Horrebow was of the same opinion. This view is based on the fact that both Horrebow and the Icelanders had seen white foxes in full summer, and is no doubt to be explained by the fact that occasionally the white dress is not changed for the summer brown. On the other hand, I believe that some authors still maintain the distinctness of the two forms, though I am not aware how they overcome the evidence of those who have observed the phases intermediate between the two which occur at the moulting season.

In his "Colours of Animals" Prof. Poulton quotes the

case of three Arctic foxes from Iceland in the Zoological Gardens, of which "one turns perfectly white every winter, while the other two remain dark."

Cambridge, November 12. W. F. LANCHESTER.

The Magnetic Storm of October 31.

DR. GLAZEBROOK has asked me to send you a copy of one or more of the magnetic curves during the late storm, and also of a characteristically "quiet" day. For the latter I send copy of declination October 2–3, 1900, B_1, Fig. 2. It is not absolutely quiet very few days are, if any—and parts show the tiny "magnetic waves" often met with. Here, as usual, there are two days' curves, each with its own base (or time) line on the same sheet. The paper is changed every second day, shortly after 10 a.m. In this quiet day declination curve, 1 cm. of ordinate in the original represents 8′.7, and increasing ordinate answers to increasing westerly declination.

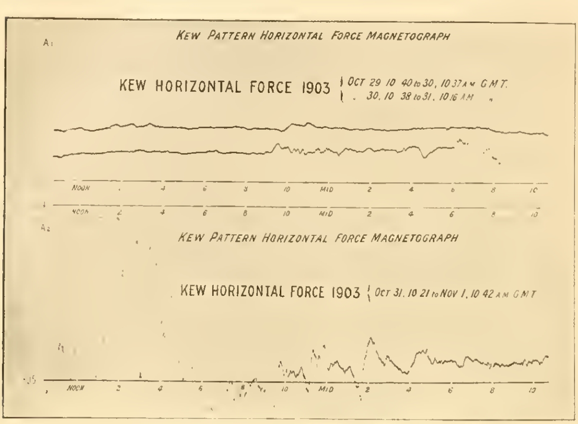


FIG. 1.—Reduced Registers of Horizontal Force.

The magnetic storm on October 31 commenced about four hours before the papers were changed, and the assistant in charge, noticing that a storm was in progress, arranged that the papers should be changed again next day, so as to have only one day's trace on the sheet, and so no mixing of two days' traces. As the commencement at 6.3 a.m. is of interest, I am sending two sheets of the horizontal force record, Fig. 1, the one, A_1, covering the interval October 29, 10.40 a.m., to October 31, 10.16 a.m., the other, A_2, October 31, 10.21 a.m., to November 1, 10.42 a.m. On October 31 some of the trace is off the sheet about 10 a.m., also between 2 and 4 p.m. and between 5 and 7 p.m. The time or base line answers to an arbitrary value (determined by the absolute observations), and 1 cm. of ordinate in the original curve represents 50γ (where $1\gamma = 1 \times 10^{-5}$ C.G.S.), increasing ordinate representing increasing force.

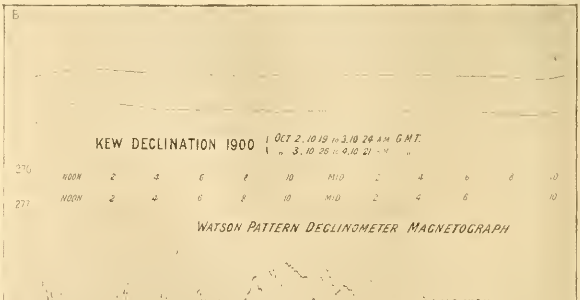


FIG. 2.—Reduced Registers of Declination.

I also send a copy of part of the declination record, B_2, Fig. 2, given by a Watson pattern magnetograph made by the Cambridge Instrument Company, sent to the Laboratory for test. The original shows, I think, all the movement, which was partly lost on our own magnetograph, the scale of ordinates of which is more open. In this curve 1 mm. represents in the original very nearly 1′ of arc, and increasing ordinate decreasing westerly declination. We had not set the clock driving this instrument quite correct, and the times shown in the trace are about four minutes wrong.

During the rapid movements the traces on the originals are faint, and consequently are not fully shown in the photographic copies sent you.

I ought to explain that the slight blurring and want of clearness on the horizontal force trace October 29–31 really arise from the electric trams. Their action, however, is hardly visible during the storm proper in either declination or horizontal force. In the vertical force, however—of which no copy is sent—the electric tram disturbance is much more considerable, and might easily be mistaken by the uninitiated for a fairly active magnetic storm.

In the accompanying illustrations, Figs. 1 and 2, 1 cm. represents practically 4 cm. of the original curves.

SUPERINTENDENT OBSERVATORY DEPARTMENT.

The National Physical Laboratory, Richmond, Surrey, November 7.

Expansion Curves.

IN your issue of October 8 Prof. John Perry describes in a letter "an exceedingly simple, ingenious method" of plotting the so-called polytropic curve representing the law pv^n = constant, which method he found in a pamphlet by Mr. E. J. Stoddard, of Detroit. I may be permitted to state that this method was published for the first time eighteen years ago by Prof. E. Brauer in the *Transactions* of the Society of German Engineers, 1885, p. 433, and since Prof. Brauer's publication this method has been used in a number of treatises on thermodynamics published in Germany and France. It has been given for years in the very valuable handbook "Huette," which is undoubtedly known to Prof.

Perry. Is it not surprising that a method which Prof. Perry himself considers very important should have to reach England from Germany by the circuitous path of the United States?

The reorganisation of technical education in England has occupied the wisest men in England for the past thirty years. It seems to be of so much importance that it has been made the subject of Sir Norman Lockyer's recent presidential address before the British Association. It seems to me that a plea might well be made for the acquisition of a reading knowledge of modern languages, especially French and German, in the advanced public schools. Prof. Perry re-discovered in an American paper, eighteen years after its first publication, a very important method for constructing a curve continually used in thermodynamics. Nineteen years ago Prof. Herrmann originated and described the entropy diagram, so often attributed to Mr. Macfarlane Gray, through whose admirable paper, read in 1889, the entropy diagram has since come into general use. There are a number of similar cases which might be cited in favour of the cultivation of a reading knowledge of those modern languages which are apt to contain valuable contributions to scientific knowledge. Forty-three years ago Prof. Huxley wrote, "What is it that constitutes and makes man what he is? What is it but his power of language—that language giving him the means of recording his experience—making every generation somewhat wiser than its predecessor—more in accordance with the established order of the universe? What is it but this power of speech, of recording experience, which enables men to be men. . . ." We might paraphrase Huxley's words and apply them to the advantage that a knowledge of the modern languages gives its owner in regard to utilising the experience of other men and nations.

B. A. BEHREND.

Station H, Norwood, Cincinnati, Ohio, October 26.

IT was of very little importance to me to find out whether the method was new; the important thing was that it was not generally known in England, that I, who read a good deal, had never seen the method, and that many of my friends who read French and German engineering books more than I do had never seen it. I may say without any contrition that there are useful things not only in French and German, but in Italian, Russian, and Chinese, as well as in English books unknown to me and to many other people, but surely this is not enough for an argument for the absolute necessity for a study of Chinese or German. Before our "advanced public schools" take up the study of French and German or Chinese, I should like to see them take up the study of English. In America and Scotland English is really well taught in many schools; this is not the case in England.

J. PERRY.

November 11.

The Leonid Shower of 1903.

QUITE an abundant and attractive display of Leonids was observed here this morning (Monday, November 16). I began to watch the north-eastern sky at midnight (following November 15), and found meteors increasingly numerous. After 2 a.m. November 16, the numbers appearing in alternate intervals of fifteen minutes were as follows:—

	h.	m.		h.	m.		Leonids
Nov. 16 ...	2	0	to	2	15	a.m.	10
	2	30	to	2	45	,, ...	14
	3	0	to	3	15	,, ...	13
	3	30	to	3	45	,, ...	13
	4	0	to	4	15	,, ...	26
	4	30	to	4	45	,, ...	34
	5	0	to	5	15	,, ...	28
	5	30	to	5	45	,, ...	42
	6	0	to	6	15	,, ...	21

The horary rate of apparition for one observer was approximately as under:—

		Leonids
0 to	1 a.m.	16
1 to	2 ,, ...	20
2 to	3 ,, ...	48
3 to	4 ,, ...	52
4 to	5 ,, ...	120
5 to	6 ,, ...	140

Maximum 5h. 30m. to 5h. 45m. a.m., when the rate was nearly three per minute.

The position of the radiant point was at $151^\circ + 22^\circ$, and it formed an area about 6 degrees in diameter. The great majority of the meteors, however, diverged accurately from the central part of the area.

During the minute following 3h. 44m. a.m. five Leonids appeared.

The meteors generally were very bright, and comparatively few were seen fainter than second magnitude. The more conspicuous objects were as follow:—

Nov. 16 a.m. h. m.	Mag.	From α °	δ °	To α °	δ °
0 36 ...	1	... 122 +	$24\frac{1}{2}$ ...	103 +	$23\frac{1}{2}$
1 13 ...	1	... $119\frac{1}{2}$	48 ...	97	$53\frac{1}{2}$
2 36 ...	Sirius ..	$117\frac{1}{2}$	$26\frac{1}{2}$ ...	98	$26\frac{1}{4}$
2 43 ...	1	... 162	$38\frac{1}{2}$ ...	168	44
2 44 ...	♃	... 73	$72\frac{1}{2}$ ...	17	63
4 4 ...	1	... $168\frac{1}{2}$	37 ...	186	45
4 12 ...	♃	.. 70	70 ...	19	59
4 37 ...	♃	... 138	35 ...	133	39
4 45 ...	♃	... 92	53 ...	68	$52\frac{1}{2}$
4 45 ...	♀	... 138	12 ...	134	$7\frac{1}{2}$
5 11 ...	1	... 213	29 ...	223	27
5 14 ...	♃	... 173	$40\frac{1}{2}$ ..	190	47
6 5 ...	♃	... 182	51 ...	195	$55\frac{1}{2}$

A few meteors were noticed from minor showers, two particularly interesting objects being:—

a.m. h. m.					
3 41 ...	4	... 219 +	63° ...	209° +	$61\frac{1}{4}$°
3 59 ...	2	... 178	19 ...	223	41

These moved very slowly, and probably belonged to radiants at $262^\circ + 62^\circ$ and $147^\circ - 11^\circ$ respectively.

I should be glad to hear of duplicate observations of any of the above, as it is desirable to compute their real paths if the necessary materials can be obtained.

Bristol, November 16. W. F. DENNING.

Autophyllogeny in the Vine (Vitis).

I LATELY received from a neighbour a vine-leaf, taken from his own garden, exhibiting the uncommon phenomenon known as "autophyllogeny." A small green leaf had arisen from the midrib, near the apex of the central lobe, upon the upper surface of the leaf. The supernumerary leaf was sessile, and had its upper surface turned towards the corresponding surface of the primary leaf, in the same direction of growth. The leaflet appeared to be of the normal shape, but, owing to a slight malformation, it was not fully expanded, and I could not therefore entirely satisfy myself upon this point.

Dr. Masters, in his "Vegetable Teratology," cites instances in which supernumerary leaflets have been observed upon the upper surfaces of leaves of Heterocentron and Miconia, and upon the under surfaces of leaves of other plants, but I cannot find any record of their occurrence in the vine.

HERBERT CAMPION.

Walthamstow, Essex.

The "Dew-bow."

ON Wednesday and Thursday, November 4 and 5, fogs prevailed in this district and brought by mild winds great quantities of carbonaceous dust from over the town, which covered the surface of the top pond in Vernon Park with a dry film. On the morning of Friday, November 6, hoar frost covered the grass and walks; the film of dust on the pond was covered with a glistening coat of minute watery globules. At 11.20, standing with my back to the sun, I noticed a bright streak of light on the surface of the water, and on moving a few feet further saw that it was split up into the colours of the prismatic spectrum, and presented the appearance of the rainbow, as it appeared curved. There were two spectra, one fainter than the other. The phenomenon was visible for more than four hours, and I directed the attention of several gentlemen to it. In November, 1885, Mr. Thomas Kay, Moorfield, Stockport, saw a similar phenomenon on Lake Windermere, and pub-

lished the observation. The things necessary to produce it appear to be:—(1) a dry film of dust on surface of water; (2) a layer of fine globules of moisture on the film; (3) a dead calm, that the globules be not shaken into coalescence; (4) the sun shining brightly at a low angle through a clear atmosphere. EDWARD HEWITT.

Municipal Museum, Vernon Park, Stockport, November 11.

Weather Changes and the Appearance of Scum on Ponds.

IF the scum referred to (NATURE, November 5, p. 7) be organic in character—algal, for instance—it would contain bubbles of gases.

Would not these bubbles tend to enlarge, from the expansion of their contained gases, on a lowering of barometric pressure, and the mass, becoming specifically lighter, to rise?

"Platanus orientalis" says "any decided change of weather." The above explanation would hold good only for a change of weather indicated by a falling barometer. H. J. GLOVER.

Stationers' School, Hornsey, N., November 6.

Earthquake at Kashmir.

IT may perhaps be of interest to note (I do not find the fact recorded in NATURE) that on April 18, 1902, there was a sharp earthquake shock over North-west India and Kashmir, about 2.30 a.m. (local time). O. ECKENSTEIN.

34 Greencroft Gardens, London, N.W., November 13.

A NEW THEORY OF THE SOIL.[1]

IT has long been recognised that the chemical composition of the soil affords a very imperfect index to its fertility, partly due to the fact that only recently have methods of analysis been devised to discriminate between the total plant food in the soil and that which is active and likely to be immediately available for the plant, but chiefly because the physical texture of the soil and its power of maintaining a supply of water to the growing plant is a much larger factor in crop production than its store of nutrient material.

But though the part played by the chemistry of the soil has doubtless been much exaggerated and requires to be studied more in connection with soil physics, it has been reserved for the chemists of the United States Bureau of Soils to deny its action entirely, and put forward a theory which considers all soils to be effectively the same from the chemical standpoint.

Briefly stated, the thesis developed in the *Bulletin* before us is as follows:—dissatisfied with the want of correspondence between the results of any of the methods of soil analysis in which the soil is attacked by either weak or strong acids, Dr. Whitney and his associates have fallen back on the aqueous solution obtained by shaking 100 grams of the soil with 500 c.c. of water and allowing it to stand for twenty minutes. For the rapid quantitative examination of the very weak solution thus resulting they have worked out various colorimetric methods, and in this way have been able to analyse several hundred soils of the behaviour of which in the field something was known.

From these results the authors come to the conclusion "that with occasional exceptions the composition of the soil solution and the concentration is about the same in all cultivable soils." "All our principal soil types, in fact, practically all cultivable soils, contain naturally a nutrient solution which varies within comparatively narrow limits with regard either to composition or concentration, and which is usually sufficient for plant growth. Apparently, therefore, all soils are amply supplied with the necessary mineral plant foods, and these plant foods are not in themselves a matter of such paramount importance to the agriculturist, for their supply as regards the plant is determined by the supply of soil moisture which the crop can obtain from the soil." The authors further suggest that fertilisers, if they have any effect in increasing the crop, do so in the main by altering the physical texture of the soil or by stimulating the root range of the plant. So novel a point of view from men with the experience of Dr. Whitney and his colleagues demands a careful consideration of the evidence in its support.

On the theoretical side the authors suggest that in the natural soil solution on which plants feed "the quantity of any constituent which can possibly enter the solution is . . . determined by definite equilibrium conditions with the but slightly soluble mineral from which it is derived . . . it may very well happen that the addition of comparatively small amounts of a readily soluble potassium salt to a soil would simply force back the dissociation and solubility of the potash minerals with no consequent gain of potassium to the soil solution." In support of this view the authors describe an experiment in which powdered potash felspar when shaken up with water is shown to yield a feebly alkaline solution, as indicated by phenolphthalein. On adding, however, a little soluble potassium salt the colour of the phenolphthalein is partly discharged, which the authors consider to indicate that some of the potash derived from the felspar has been forced back to the solid phase. We would suggest the consideration of another experiment; take a very weak solution of potassium phosphate, add a drop of phenolphthalein solution, and run in dilute alkali until a distinct colour appears; now add a little solution of some neutral salt, sodium or potassium chloride; the colour will again be partially discharged, although the salt added is strictly neutral.

In the latter experiment there is no question of the intervention of a solid phase; both experiments are, we think, equally explicable on the dissociation hypothesis, but the one does not bear the interpretation put on it by the American chemists.

Turning now to the analytical figures, we cannot agree that, except in a very general and average sense, they support the authors' case that the composition and concentration of the soil solution are about the same for all soils. Taking first of all the determinations of nitric acid, they are seen to vary within the widest limits, as is evident from the following summary of the results for four of the soils:—

	No. of analyses	Nitric acid. Parts per million of dry soil		Mean
		Highest	Lowest	
Windsor Sand ...	34	26·62	0·56	5·69
Norfolk Sand ...	98	23·76	0·67	3·81
Leonardtown Loam	62	62·00	trace	12·71
Sassafras Loam ...	80	38·40	0·50	7·79

Furthermore, if the number of the determinations falling within successive equal limits be plotted into a curve, the resulting figure is highly irregular, and shows nothing of the maximum about the mean which characterises the curve of error. The nitric acid figures are thus entirely opposed to the authors' thesis; they show no tendency to a constant value, but extreme accidental variations, *i.e.* due to factors independent of the classification here adopted. But in fact too

[1] "The Chemistry of the Soil as related to Crop Production." By M. Whitney and F. K. Cameron. U.S. Department of Agriculture, Bureau of Soils, No. 22. Pp. 71. (Washington, 1903.)

much is known of the origin of the nitrates in the soil from the results obtained by Warington at Rothamsted and by King in Wisconsin to allow one to suppose their amount would ever approximate to a constant even for the same soil, yet nitrates are perhaps the dominant factor in plant nutrition.

The phosphoric acid and potash figures are a little more in harmony, and we have examined those relating to the same four soils with the following results:—

	Phosphoric acid. Parts per million		
	Highest	Lowest	Mean
Windsor Sand	12·88	2·65	6·21 ± 0·25
Norfolk Sand	16·52	1·71	6·33 ± 0·19
Leonardtown Loam ...	16·5	2·9	7·16 ± 0·26
Sassafras Loam	21·45	2·24	7·61 ± 0·30

	Potassium. Parts per million		
	Highest	Lowest	Mean
Windsor Sand	46·11	10·90	24·27 ± 1·02
Norfolk Sand	44·9	11·64	22·19 ± 0·49
Leonardtown Loam ...	51·66	10·08	23·61 ± 0·65
Sassafras Loam	46·8	7·94	24·22 ± 0·63

These numbers would indicate variation round a mean which is practically the same for all soils as regards potash, but which as regards phosphoric acid has a different value for different types of soil, approaching one value for sands and another for loams. This agrees with the probability that the potash compounds are of the same type in all soils, whereas several distinct compounds of phosphoric acid must exist in relative proportions varying with the type of soil, and we surmise that these mean results might be correlated with the amount and solubility of the compounds appropriate to the various types of soil were more data available. But for the purpose of the argument we are not concerned with mean results, but with individual soils; the authors rest their case on the constancy of composition of the soil solution, and their own figures show variations too wide and too numerous to fall within any allowable limits. It may be true enough that the variations exhibited cannot be correlated with the known productiveness of the soils, but that is only a proof of the ineffectiveness of the analysis of the aqueous extract of a soil, not of the non-existence of a chemical soil factor in crop production. Indeed, it is not quite easy to see what the numbers do represent; the volume of water employed is so small, and the time of extraction so short, that they cannot stand either for the solution existing in the soil or for the material which water could extract during the growth of a crop. Some analyses are given of the actual solution extracted from various soils; all that can be said of them here is that they show no more constancy of composition than the laboratory extracts, nor do the old analyses of the drainage waters at Rothamsted lend any more support to the idea of a soil solution of constant composition.

Though Dr. Whitney's main argument is thus hardly tenable on his own showing, certain side issues are worth a little notice. Dealing with the action of fertilisers, he notices that, while the wheat crop on the best fertilised plot at Rothamsted averages about 33 bushels, on the plot which has been unmanured for sixty years it has fallen to 12 or 13 bushels. Yet on the similarly unmanured plot in the Agdell field, where the wheat is grown once every four years in rotation with roots, barley, and clover or fallow, but little falling off is apparent. Hence he concludes that, in virtue of the rotation, the fertility of the Agdell field is unimpaired, whereas in the continuous wheat field "the decrease can be ascribed only to some physical change in the soil, to some chemical change other than the actual loss of plant food taken up by the crops." But when any other crop on the unmanured plots in Agdell field is considered, the decline in fertility is enormous; roots and clover only yield minimal crops; so far as they are concerned the cultivation of the soil involved in the rotation has been quite unable to maintain the fertility. The wheat, with its powerful root system, holds up better, but its production is falling steadily; it is important to see how long it will be maintained, though it need never be expected to fall to the level of the continuous wheat, because the land is practically only cropped every other year, so trifling has the output of roots become.

When Dr. Whitney says that there are few instances showing that a given fertiliser is required by a certain soil, and that generally fertilisers have no consistent or continuous effect, he ignores too much the results both of experiment and experience in countries like our own. In England a body of knowledge has been accumulated concerning the requirements of particular soils and crops for specific fertilisers such as is hardly possible in America, where much of the land has only recently been brought under intensive cultivation involving the use of purchased manures.

In another place Dr. Whitney says "the beneficial effect of fallowing is not due to an accumulation of soluble plant food in the soil." Not wholly due, perhaps, but King's investigations show what a powerful factor the accumulated nitrates become, and a recent discussion of the Rothamsted results shows that after a wet autumn, to wash out the nitrates formed during the summer fallow, the benefit of fallowing disappears almost entirely, whereas after a dry autumn and early winter it produces an increase of crop of nearly 50 per cent.

Suggestive as Dr. Whitney's memoir must be to all agricultural chemists, we thus do not consider that the main theory it propounds possesses any permanent value. We should be sorry if we have failed to appreciate the argument properly, but it is not always easy to follow, the text being somewhat deficient in sequence and orderly arrangement; indeed, we are disposed to think that had the question been set out a little more nakedly at the outset, and the demonstration marshalled with more precision, a somewhat different conclusion would have been reached by the authors. The fundamental thesis is unimpeachable, that water content and temperature are the main factors in crop production, but the chemical composition of the soil is also a large factor, though its magnitude and relation to the other physical factors do not yet admit of complete determination.

A. D. H.

THE SURVEY OF INDIA.

A VOLUME of extracts from narrative reports of the Survey of India for the season 1900–1901 [1] has recently been issued. These extracts, which used to be published in the same volume as the annual report, are now issued separately. The reports selected for publication show admirably the range of the operations of the Survey of India. They deal with seven subjects.

(1) *Zincography*.—For certain classes of maps reproduction from zinc is eminently suitable, and owing to the introduction of thin zinc plates, difficulties of

[1] Pp. 68. (Calcutta: Government Printing Office, 1903.) Price 2s. 3d.

storage have largely disappeared. For the rapid reproduction of maps photozincography was, until a few years ago, the method invariably used. Two new methods have now superseded photozincography; one of these, "heliozincography," was worked out by the Ordnance Survey, and subsequently adopted by the Survey of India; the other, the "Vandyke process," was invented by Mr. Vandyke, of the Survey of India, and has now been adopted by the Ordnance Survey. The first method consists in reproduction direct on a sensitised zinc plate in contact with a reversed negative. The Vandyke process consists in reproduction direct on a sensitised zinc plate in contact with the original drawing. Lately, at Southampton, it has been even found possible to reproduce maps drawn on thick drawing paper. The process has been patented by Mr. Vandyke, and is a cheap and very efficient means of reproducing cadastral maps.

(2) *Geodetic Triangulation in Burma.*—The principal point to note is the determination of the coefficient of terrestrial refraction by night as well as by day, the coefficient being the absolute refraction divided by the terrestrial arc. By day (from observations to heliostats between noon and 3 p.m.), the coefficient was 0·072; by night (from observations to lamps), 0·083. It is possible that if the night observations had been taken from midnight onwards the coefficient would have been smaller.

Some interesting secondary triangulation (the Manipur series) was also carried out, one of the rays being 95 miles long.

(3) *Latitude Operations.* The average probable error of 14 latitudes observed with a zenith telescope was $\pm 0''.063$, or say six and a half feet. India is, of course, committed to the system of refined latitudes, and comparatively few of them.

(4) *Experiments with the Jäderin Base Apparatus.*—A base was measured at Dehra Dun with the following results:—

By Jäderin apparatus...	...	39,187·272 feet
By Colby's bars ...	...	39,187·462 ,,

a discrepancy of 1/194,000.

It was found that the 80 ft. wire was the most convenient, and various practical suggestions are made on the use of the apparatus. It was apparently in contemplation to measure a Jäderin base in Burma. There would appear to be no doubt as to the gain in speed, and also no doubt that it is possible under suitable conditions to do away with base-line figures by the use of, say, 15 mile bases.

(5) *Magnetic Survey of India.*—This has been commenced, and there are now five base stations, Calcutta, Bombay, Rangoon, Dehra Dun, and Kodaikanal. It was intended in 1901 to send out three field detachments to work in an area west of a line joining Dehra Dun and Bombay, two to work along railway lines, and a third in the desert.

(6) *Tidal and Levelling Operations.*—Tidal observations have been, or are being, taken at forty-one ports in, and adjacent to, the Indian Empire. Tables are given of the tidal constants at various ports deduced from the 1900 observations. As regards the accuracy of prediction, at fourteen open coast stations during 1900 it was found that the mean error of prediction of the time of high or low water was thirteen minutes, and the average error of predicted heights was one twenty-fifth of the range.

The tide-predicting machine belonging to the Indian Government (due, it is believed, to Lord Kelvin and Mr. Roberts) is in London, and the Survey of India sends home annually the latest values of the tidal constants to Mr. Roberts, who sets the instrument for the port in question, and causes it to describe graphically the tide curve for any future year required. As Prof. Darwin has remarked in his book on "The Tides," it is characteristic of England that this admirable machine has not been made use of for any of the home ports.

(7) *Topographical Surveys.*—The seventh report deals with some details of one-inch work in Burma, and incidentally serves to emphasise the necessity of keeping cadastral and topographical work distinct. The topographical surveys are fully described in the annual report, the most interesting being the survey on a scale of half inch to one mile of 17,000 square miles carried out in China during the expedition.

When shall we have an Imperial Survey capable o' doing for the Crown colonies, protectorates and occupied territories what the Survey of India does for India?

C. F. C.

ISAAC COOKE THOMPSON.

Liverpool has lost a well-known naturalist in the death of Mr. I. C. Thompson, who was hon. treasurer of the Liverpool Marine Biology Committee from its foundation nearly twenty years ago. He had a wide knowledge of the Crustacea, and especially of Copepoda, the group upon which most of his original work was done, but he was also a keen field-naturalist, interested in the lives and habits of his animals, and preferring to catch the specimens himself and to examine them in the first place alive. He was always a prominent member of the party during the dredging expeditions in the Irish Sea and at the Port Erin Biological Station. Little more than a month before his death he was one of the leaders in the British Association dredging excursion which followed the Southport meeting.

Thompson's early papers on the Copepoda dealt with the forms found in Liverpool Bay and other parts of the Irish Sea, but he collected wherever he went, and, as the result of vacation travels, published papers on the Mediterranean and Norwegian species and on collections from Madeira, the Canaries, the west coast of Ireland, the Færöe Channel, and a traverse through the North Atlantic to Quebec. He also described Copepoda from the Bay of Bengal, the Antarctic, the Red Sea and east coast of Africa, and recently from the *Oceana* Expedition in the North Atlantic. In these papers he described many new forms, aided in the elucidation of not a few obscure points, and greatly extended our knowledge of the geographical distribution of the group. Thompson's last piece of scientific work was a large report, undertaken jointly with Mr. Andrew Scott, upon the Copepoda of the Ceylon pearl banks, recording more than 280 species, of which 76 are described as new to science. This extensive work was completed some weeks ago, and Thompson passed the last of his sheets for press shortly before he was struck down; it has been referred to by one who saw the proofs as the pioneer work on tropical Harpacticidæ and Lichomolgidæ. Thompson's papers have been published for the most part in the *Transactions* of the Liverpool Biological Society, the *Journal* of the Linnean Society, the *Annals and Magazine of Natural History*, and the reports of the British Association. He was in correspondence with Claus, Richard, Giesbrecht, and other Continental workers, and frequently supplied them with British specimens required for comparison or description in their monographs.

There were few of the local organisations in Liverpool for the advancement of science and the applications of scientific teaching in which Mr. Isaac Thompson did not play a prominent part, and his posi-

tion, even twenty years ago, was fitly indicated by his selection, in April, 1882, to attend Darwin's funeral in Westminster Abbey as the representative of the Liverpool scientific societies. On the occasion of the last visit of the British Association to Liverpool, in 1896, Thompson was one of the local secretaries, and his colleagues can testify how well he did his share of the hard work, and how much the success of that large meeting depended upon his admirable business arrangements and careful attention to detail. He was a fellow of the Linnean Society and a regular and active member of Section D at British Association meetings. He was one of the founders of the Liverpool Biological Society and the L.M.B.C., and it was in connection with the latter, and during the last fifteen years, that most of his original scientific work was done.

Isaac Thompson was a good example of the serious amateur who does sound systematic work and makes lasting contributions to science. His loss will be keenly felt, not only in Liverpool, but by the large number of scientific men throughout the country who were his personal friends. We all admired his sterling, upright character and his sympathetic loving nature.

W. A. H.

NOTES.

Prof. J. H. van 't Hoff and Dr. Robert Koch have been elected honorary members of the Vienna Academy of Sciences. Sir William Ramsay, Prof. G. B. von Neumayer, Prof. H. Poincaré, Prof. E. J. Marey, and Prof. K. Golgi have been elected foreign correspondents of the same Academy.

The death is announced of Prof. Robert H. Thurston, of Cornell University, at the age of sixty-four. From 1866 to 1871 Prof. Thurston occupied the chair of natural philosophy at the United States Naval Academy. Subsequently he became professor of engineering at Stevens Institute, where he remained until he proceeded to Cornell, in 1885, as professor of mechanical technology.

Dr. Einar Lönnberg has been appointed director of the zoological department of the Museum of Gothenburg.

Reuter reports that two earthquake shocks were felt at Shuraz, Persia, on the night of November 14.

Mr. W. J. Palmer, a graduate of the Ontario Agricultural College, has been appointed director of agriculture in the Orange River Colony at a salary of 1200*l.* per annum.

The sixth International Congress of Applied Chemistry is to be held at Rome in 1906. Prof. E. Paterno, of Rome, has been elected president of the organising committee.

It is stated by *La Nature* that the body of a Tyrolese guide who fell into a crevasse on the glacier of Gross-venediger, in the Austrian Alps, thirty years ago, has been found in a remarkable state of preservation at the foot of the glacier.

A monument to the brothers Haüy was unveiled at their birthplace, Saint-Just-en-Chaussée (Oise), on November 8. The elder brother, René Just Haüy, who died in 1822, was the eminent mineralogist. The ceremony was presided over by M. Edmond Perrier.

At a meeting of the Royal Statistical Society held on Tuesday, the president, Major P. G. Craigie, C.B., delivered his opening address. Before doing so he presented, on behalf of the council and the society, a Guy medal in silver to M. Yves Guyot, for his paper on "The Sugar Industry of the Continent," which was read before the society on May 29, 1902.

The Craggs research prize, for the best piece of original work done during the current year by present or past students of the London School of Tropical Medicine, has been awarded to Dr. Aldo Castellani for his researches into the etiology of sleeping sickness. Dr. Travers has been awarded honourable mention for his paper "Beri-Beri."

Commander Peary was, on November 12, in Edinburgh, presented with the Royal Scottish Geographical Society's Livingstone gold medal. Previous awards of the medal were to Sir Harry Johnston for discoveries in Africa, and to Dr. Sven Hedin for exploration in the central region of the Ural-Asian continent.

Mr. M. H. Maw, of Walk House, Barrow-on-Humber, states that the radiant point of meteors seen by him in the early hours of Monday seemed to be about ten degrees south of the zenith. Meteors under the Pole Star seemed to move vertically down through 30° in about half a second. Taking the altitude of such a meteor to be eighty miles, the length of the arc described in half a second would be forty-two miles if the motion were at right angles to the line of sight.

A Reuter telegram from Rome reports that experiments made by the Italian naval authorities with a new system of radio-telegraphy originated by Prof. Alessandro Artom have conclusively proved that the new system enables electric waves to be transmitted in a given direction. The Minister of Marine has instructed Lieutenant Pullino, director of the wireless telegraph station of Monte Mario (Rome), to give every assistance in further experiments with the Artom system.

The *Times* reports that the expedition to Tibet, under Captain Rawling and Lieutenant Hargreaves, of the Somerset Light Infantry, which left Leh in Ladak last May, arrived in Kashmir territory on October 4. Triangulation was extended as far as longitude 85° E., the highest latitude being 35° 45′, and lowest 32° 45′. Many new lakes were discovered, the largest having an area of 70 square miles. One hundred points were fixed by triangulation, and latitudes of all the camps by astronomical observations; 38,000 square miles of country were surveyed.

The following prizes have been awarded by the council of the Royal Society of Edinburgh:—(1) the Keith prize for 1899–1901 to Dr. Hugh Marshall for his discovery of the persulphates, and for his communications on the properties and reactions of these salts, published in the *Proceedings* of the Society; (2) the Makdougall-Brisbane prize for 1900–1902 to Dr. Arthur T. Masterman for his paper entitled "The Early Development of *Cribrella oculata* (Forbes), with remarks on Echinoderm Development," printed in vol. xl. of the *Transactions* of the Society. The prizes will be presented at the meeting of the Society on December 7.

A correspondent of the *Times* reports that on November 12 a balloon belonging to MM. Lebaudy, and called *Le Jaune*, started from Moisson, about 55 kilometres from Paris, at 9.10 a.m., arrived at the Eiffel Tower at 10.50 a.m., and effected its descent on the Champ de Mars. According to M. Juchmès, an aëronaut and one of two passengers, the balloon encountered at first a south-south-west wind travelling at the rate of six metres a second. Almost the whole way he had to keep the point of the balloon somewhat to the right of the direction he intended to take. The maximum altitude attained was 300 metres, but the average was about 100.

Announcement is made of the proposed publication of a new journal under the title *Archivio di Fisiologia*, edited by Prof. Giulio Fano, director of the physiological laboratory at Florence. The journal will be especially concerned with experimental work, but synthetic reviews and philosophical disquisitions will not be excluded from it. Contributions will be published, according to the wish of the author, in English, Italian, German or French. The *Archivio di Fisiologia* will appear every two months, forming a yearly volume of about 500 pages. The English agents are Messrs. W. Heffer and Sons, Cambridge.

Mr. E. Kitto, superintendent of the Falmouth Observatory, sends some particulars of the recent magnetic storm registered at that observatory. Commencing on October 31 at 7 a.m., the disturbance continued until 5 a.m. on November 1. It was severe from 7 a.m. to 7 p.m. on October 31, but the period of exceptional severity was between 1 p.m. and 7 p.m., during which time the declination magnet swung through an arc of 2 degrees 2 minutes, as determined by actual measurements of the declination curve. The Falmouth Observatory magnetic records are continuous from January, 1887, but the magnetic storm of October 31 stands out as the most remarkable record of magnetic disturbance ever made at the observatory.

It is reported by the *Pioneer Mail* that the Secretary of State for India has definitely sanctioned the scheme for establishing an agricultural college at Pusa, in the Muzaffarpur district. The intention is to combine a large experimental farm and an agricultural college with an institution for research, so as to form a great Imperial institution. The fine Government estate at Pusa will be the headquarters of the staff of various experts, including an agricultural chemist, who will be mainly an analyst and cryptogamic botanist, whose business it is to investigate the diseases which attack the principal indigenous crops, and an entomologist, charged with the study of insect pests. A cattle farm for the improvement of the local breed of cattle will also be included.

A lectureship has been endowed in the University of Birmingham by an anonymous friend in memory of the late Prof. Huxley. We learn from the *British Medical Journal* that the lecture is to be given annually, either in the winter or spring terms, and to be open to all members of the university without payment. It is to be called the Huxley lecture, and for its endowment a sum of 20*l.* per annum has been given. The lecture will also commemorate the opening of Mason's College, the predecessor of the university, by Prof. Huxley. As the donor has expressed a wish that the first lecture should be given by someone who knew the late Prof. Huxley intimately, and who was associated with his work, it has been decided by the council on the recommendation of the Senate to invite Sir Michael Foster, K.C.B., F.R.S., to deliver the first lecture.

On the completion of the portrait of the late Prof. P. G. Tait for the Hall of Peterhouse, Cambridge, the treasurer was able to announce a surplus in hand. It was therefore suggested that an attempt should be made to increase this amount until it should suffice for the establishment in the college of a prize associated with Prof. Tait's name, and to be given for excellence in his subject, physics. Mention was made of this project in our issue of October 22 (p. 603); and we now learn that a final report made to the master and fellows of Peterhouse on October 29 showed that the amount of the fund had reached the substantial total of 200*l.* A committee was appointed to draw up regulations for the award of the prize, and record was made of the gratitude of the college to all who have united in establishing this worthy memorial of a renowned *alumnus* of Peterhouse.

Mr. R. Kaye Gray, in his presidential address to the Institution of Electrical Engineers last Thursday, dealt with a number of subjects of importance and interest. He referred at some length to the development of electric traction and power-supply in this country, and laid considerable stress on the difficulties caused by faulty legislation, which had hampered the progress of these branches, and, indeed, to a certain extent, of all electrical engineering in England. All engineers will join in his hope that the Government will speedily carry out the promises made to the deputation headed by Mr. Swinburne last year, and will both introduce and carry through really effective amending measures. Mr. Gray referred to the fact that the Institution had recently purchased a site for building a permanent home for itself, and said that there was no intention of building as yet, partly because it was possible that in the near future the various engineering interests might unite to build "one large temple of engineering," in which all might find a home.

For several years past valuable statistics of rainfall and other meteorological phenomena recorded at Zomba, in British Central Africa, have been published by the scientific department of that protectorate; the head of that department is Mr. J. McClounie. We are somewhat surprised to find that, as the head of a public department, he has ventured to depart from the orthodox scientific methods adopted by official meteorologists, and has issued daily rainfall forecasts from June 1903 to May 1904, and estimated monthly amounts for various parts of Nyasaland. He states that "the forecasts have been framed according to the relative positions of the moon and the sun on the dates noted, and the estimates formed according to the various movements of the moon, and proportionate to our knowledge of the average rainfall of each month as regulated by latitude and altitude." Prof. Pernter, in the paper referred to in our issue of last week, has pointed out, as, indeed, Herschel stated many years ago, that the influence of the moon on weather is so small as to be almost inappreciable. We are not prepared, without further inquiry, to endorse Prof. Pernter's opinion that the adherents of the lunar theory carefully note the days on which their forecasts have been successful, but take no heed of the failures; we are, however, not yet prepared to admit that this method of forecasting weather is likely to lead to any useful results.

Some further particulars with regard to the alleged discovery of the cancer parasite by Dr. Schmidt (see Nature, November 12, p. 34) are published in the *Lancet*. These are given by Mr. H. J. Johnson in a paper read before the Abernethian Society at St. Bartholomew's Hospital. Dr. Schmidt claims not only to have isolated the parasite, but to have cultivated it, though no details are given. By the use of killed cultures a vaccine is prepared, the injection of which into a patient with cancer is stated to be followed by a reaction and by curative effects. By injecting animals with the cultures, their serum acquires antidotal properties, and may also be used for treatment. At present there is no supply either of the vaccine or serum available for treatment.

In a recent number of Nature (vol. lxviii. p. 8) a brief summary was given of the position of the present epoch in relation to Brückner's long weather cycle of 35 years, and it was there shown that as regards the total rainfall of the British Isles we have now passed a minimum or "droughty period," and are commencing a wet cycle, which will reach

a maximum about the year 1913. Mr. Douglas Archibald, in a letter to the *Times* for November 16, gives some figures which represent the variation of the rainfall over the London area from the year 1813, using Greenwich and Mr. Dines's observations. Arranging these 90 years in groups as suggested previously by Brückner, he gives an interesting table showing not only the excess or defect of rain, but also the excess or defect of atmospheric pressure and the variations of the price of wheat since 1856.

Group of years assigned by Brückner	Character of the Period	Total excess or defect of rainfall in the period	Total excess or defect of barometric pressure, Greenwich	Mean annual fluctuations of yield of wheat from the true average over the United Kingdom
		Inches	Inches	Bushels
1806–25	Wet	+15·54 [1]	−0·065 [1]	
1826–40	Dry	− 6·17	+0·165	
1841–55	Wet	+ 4·35	−0·045	
1856–70	Dry	−11·85	+0·150	+1·7
1871–85	Wet	+19·65	−0·120	−2·0
1886–1902	Dry	−29·75	+0·272	+2·2
1903–1920(?)	Wet	—	—	—

[1] 1813 to 1825 for both.

Mr. Archibald concludes his letter by saying that "we are apparently entering upon a period of more than average rainfall, less than average barometric pressure, and about two bushels less than the average wheat yield per acre."

Messrs. W. J. McNeal and F. G. Novy report that they have succeeded in cultivating the trypanosome parasite of the rat, *T. Lewisi*, in a mixture of sterile defibrinated rabbit's blood and ordinary nutrient agar. Ordinary nutrient agar is prepared, sterilised, and allowed to cool to 50° C. One-third of its volume of defibrinated rabbit's blood, obtained with aseptic precautions, is then added, and the test-tubes containing the mixture are allowed to solidify in the oblique position. Loopfuls of rat's blood containing the parasite are then sown into the condensation water at the bottom of the tubes. In this the trypanosomes readily develop at 34–37° C. During a year eleven passages were made from tube to tube, and a small quantity of the culture from the tenth tube readily infected a rat inoculated with it (ref. in *Bull. de l'Inst. Pasteur*, i., No. 16, p. 602).

The current number of the *Journal of the Sanitary Institute* (October) is mainly devoted to the papers read at the congress at Bradford and the discussions thereon. Several papers deal with the question of sewage disposal and with the bacterial systems of sewage disposal, the standardising of sewage being the subject of a joint discussion in the engineering and biological sections. The "Standardisation of Disinfectants" is the title of a paper by Messrs. Rideal and Ainslie Walker, and it is proposed to test all disinfectants under the same conditions of time, &c., and to compare the results with those obtained with carbolic acid solution. Thus if a 1 in 70 solution of disinfectant X possessed the same disinfecting action as a 1 in 80 solution of carbolic acid, the efficiency of disinfectant X compared with carbolic acid would be $70/80 = 0.87$. This is termed the carbolic acid coefficient.

A report has been issued by Prof. K. R. Koch dealing with the gravitational measurements conducted under the auspices of the Württemberg Geodetical Commission at ten stations on the line from Ulm to Freudenstadt. In these experiments a new pendulum made of Delta metal has been used with satisfactory results.

In a short paper reprinted from the *Rivista di Fisica* (Pavia), Ingegnere G. Zanotti Bianco deals with the history of determinations of the earth's mean density, with especial reference to the investigations of several Italian writers whose work has received but little attention, at any rate in this country. Among them are C. I. Giulio, Menabrea, and Saigey.

Mr. A. Cancani has published a paper reprinted from the *Atti dell' Accademia Gioenia* (Catania) dealing with the relation between the temperatures of springs and those of the air. A noteworthy feature of this paper is the bibliography of the subject. The principal previous bibliography was published by the Weather Bureau at Washington in 1899, and as only a limited number of copies were lithographed, it is probable that the present enlarged list will be of much use for purposes of reference.

The problem of correlation in hyperspaces forms the subject of an important paper by Mr. Giovanni Zeno Giambelli in the *Memorie* of the Lombardy Institution of Sciences and Letters. The author refers to the work of Hirst, Sturm, Visalli and others on correlation in plane and ordinary spaces. In regard to correlation in hyperspaces, the fundamental formulæ were published without proof by Schubert in 1890, and again in 1894–5. Mr. Giambelli now gives proofs of Schubert's formulæ, and obtains others of a more general character. The results are obtained by the method of "degeneration" introduced by Schubert in dealing with ordinary space and with quadrics in hyperspaces.

Papers by Messrs. Epsteen and Shaw in the last two numbers of the *Transactions* of the American Mathematical Society deal with the interesting subject of linear algebras, and bear witness to the value and originality of Peirce's researches. Another noticeable paper, in the July number, is that of Van Vleck on continued functions, on the lines of Stieltjes's memoir of 1894. The October number of the *Annals of Mathematics* contains the first part of a paper by Prof. Greenhill on the mathematical theory of the top, and a contribution by Mr. E. B. Wilson which deals with a generalised definition of area which does not involve the conception of length.

The September issue of *Annotationes Zoologicae Japonenses* deals solely with Japanese invertebrates. Mr. E. Klocke records the occurrence of the crustacean genus Bosminopsis in Japan; Mr. A. Izuka describes a new polygordian worm, while Mr. E. Ikeda treats of the development of the sexual organs in the phoronis larva.

In the *Morphologisches Jahrbuch* (vol. xxxi., part iv.), Dr. H. Fleischmann's essay on the morphology of the head-skeleton of the Amniota is continued, Dr. A. Beecker contributing a section on the nasal region in reptiles, birds, and mammals. Mr. G. Tornier describes numerous instances of the development of supernumerary digits in the fore-feet of members of the deer-tribe, due, in most cases at any rate, to injury during fœtal life. None of these appear to be atavistic.

A reprint from the *Cape Times* of the report of the recent annual meeting of the Game and Trout Protection Association of the western districts of South Africa affords very satisfactory reading. The laws for the protection of big game are apparently working well, certain attempts to curtail the close season having been vetoed by the Government. In some districts it has been found advisable to have a special close season for certain kinds of game, and to include therein a few species of birds which do not properly come under that category. A large tract of country in the

Bushmanland division of Namaqualand has been created a game reserve, in which it is unlawful to kill, hunt, or trap any description of game animal. Despite the Boer war, certain species of antelope, which have long been on the verge of extermination, still survive. Blesbok, for instance, are stated to be represented by about 650 head in the Steynsburg division, and bontebok by some 250 in Bredasdorp and 25 in Swellendam. Reedbuck include about 200 head in Komgha, where they are specially protected, and 50 in Kimberley. Nothing is, however, said with regard to the white-tailed gnu, which has been reported extinct, the "wildbeest" referred to being apparently the brindled gnu. Of zebra about 340 individuals survive, mostly in Cradock, George, Oudtshoorn, and Uniondale.

WE have on our table two parts (vol. lxxv., i. and ii.) of the *Zeitschrift fur wissenschaftliche Zoologie*, from among the contents of which a few articles are selected for brief mention. In the first part the light-organs of the glow-worm receive attention at the hands of Mr. J. Bongardt, while Mr. Haack treats of the glands in the mouth of the lampreys. In the second part Dr. E. Rohde continues the account of his important investigations into the structure of the organic cell, discussing, in this instance, the structure and mode of division of the wandering bodies known as "sphæres" and "centrosomes" which are found moving free in many cells and their nuclei. The gill-filters of fresh-water fishes form the subject of an article by Dr. E. Zander. It is shown that while carnivorous types like the pike have the inner sides of the gill-arches, the bones of the branchio-palatal apparatus, and the pharyngeals studded with minute villiform teeth, in forms like the perch, carps, and herrings there is a strongly developed sieve-like appendage ("Siebfortsätze") on both branches of the gill-arches. The fineness of this filtering arrangement is correlated with the habitat and food of the groups in which it occurs, attaining its extreme development in this respect in those subsisting on "plankton."

To the *Proceedings* of the American Academy of Arts and Sciences a list of new flowering plants obtained from Mexico and Central America is contributed by Miss J. Greenman. Most of the species belong to the Sympetalæ, so that they do not overlap with those recorded by Dr. J. N. Rose, which would be mainly included in the Archichlamydeæ.

A COMPARISON of the characters of the European and Australian Alpine floras is made by Mr. Weinsdorfer in the *Victorian Naturalist*. Flowers in the Australian Alps display less brilliancy of colour and are not so strongly scented, both of which facts may be correlated with the paucity of insects, but a longer vegetative period and a lower summer mean temperature must also tend to diminish the marked characters which are developed at high altitudes.

THE report of the Meteorological Service of Canada for the year ending December 31, 1901, by Mr. R. F. Stupart, the director of the department, has been received from Ottawa. The volume runs to 370 foolscap pages of meteorological statistics.

MESSRS. CROSBY LOCKWOOD AND SON have published a second edition of Mr. Tyson Sewell's "Elements of Electrical Engineering," which was reviewed in our issue for November 20, 1902. The second edition has been revised, and three chapters dealing with alternating currents have been added.

A COPY of the seventh volume of the *Transactions* of the Rochdale Literary and Scientific Society has been received. It contains an account of the proceedings of the Society for the years 1900–1903, as well as a number of the papers read before the association during these sessions. The Society is to be congratulated upon its flourishing condition, both as regards its activity and finances. The *Transactions* are published by Mr. James Clegg, of Rochdale, at 2s. 6d.

IN the review of Prof. Henrici's "Vectors and Rotors" in NATURE of October 29 (p. 617), it was mentioned that Prof. A. Lodge had suggested the use of the word "locor" to indicate a vector which has definite position, but does not indicate rotation or any rotative function. Prof. R. H. Smith writes to say that the word "locor" is used in this way throughout his book "Graphics," published by Messrs. Longmans in 1888, "rotor" being used for rotative quantities.

PARTS 9 and 10 of the first volume of the *Bulletin* of the Department of Agriculture in Jamaica are devoted to the consideration of the best means of improving the breed of horses in the island

WE have just received the report for 1902–3 of the work done in the Government Laboratory at Trinidad under the direction of Prof. Carmody. The results of a large number of seedling cane experiments, showing the relative sucrose value of different canes, form a special feature of the report.

A REMARKABLY graphic map of the British Empire, devised by Mr. Stephen Smith, is published in the October number of the *Geographical Teacher*. This map shows the British lands each in proportion to its area, and in such a position that the direction and distance from London are approximately correct. Somewhat similar results are obtained by drawing a hemisphere on an equal area projection with London in the centre, if Australasia is tacked on. Other ways of securing equivalence of area are the Mollweide and the Sanson-Flamsteed projections, where the world is shown within an oval framework. Such an oval map of the British Empire has lately been published by Messrs. Darbishire and Stanford, Ltd., Oxford.

THE question of space interference, a phenomenon first observed by V. Meyer in the case of ortho-substituted aromatic acids which can only be esterified with great difficulty, and in some cases not at all, is discussed by Prof. Skraup in connection with the cinchonine alkaloids. This interesting paper, which indicates that the alkaloids cinchonine, α-*i*-cinchonine, β-*i*-cinchonine, and allo-cinchonine have probably no fundamentally different chemical structure, but the reactions of which differ in certain respects by reason of space interference, appears in vol. xlii. of the *Sitzungsberichte* der Wiener Akademie.

IN the current number of the *Zeitschrift für physikalische Chemie*, Prof. van 't Hoff gives an account of the investigations which have been going on for some years in his laboratory relative to the transformations of gypsum. It is shown that gypsum $CaSO_4.2H_2O$ changes at 107° C. into the so-called half-hydrate $2CaSO_4.H_2O$. At this temperature, however, these two bodies are only meta-stable, for at 93° gypsum changes into the soluble form of anhydrite $CaSO_4$, which itself is in reality not stable, for under favourable conditions gypsum actually breaks up at 63°·5, and forms insoluble anhydrite found in nature and identical with dead-burnt gypsum. The laboratory investigation of these changes is rendered extremely difficult by the occurrence of retardation phenomena analogous to supercooling and supersaturation.

A RECENT number of the *Electro-Chemist and Metallurgist* contains an able article by Mr. W. C. D. Whetham on the present position of the theory of electrolysis. The investigations which led up to the theory of electrolytic dissociation and the modern convective views of electrolysis are traced, and it is clearly shown that a vast number of important observations are easily explained by the modern views. As the author points out, experiments on the comparison of the electrical and the osmotic values of ionisation are of little use from the point of view of the controversialist seeking arguments for or against the ionic dissociation theory. The deviations between the two values are, however, in most cases easily explainable by a consideration of the interionic forces, which probably exert an effect even at dilutions at which the intermolecular forces are negligible, and, further, of the complex ions which are so often formed in solution.

THE additions to the Zoological Society's Gardens during the past week include a Red-fronted Gazelle (*Gazella rufifrons*) from Senegal, presented by Lieut. F. P. Crozier; two Common Mynahs (*Acridotheres tristis*) from India, presented by Mr. H. Munt; a Hawk-billed Turtle (*Chelone imbricata*) from tropical seas, a Testaceous Snake (*Zamenis flagelliformis*) from South United States, deposited.

OUR ASTRONOMICAL COLUMN.

BRIGHT METEORS.—An exceedingly bright meteor was observed by Mr. W. Moss at South Kensington at about 11.15 p.m. on Saturday. Although not looking in the direction of its path, Mr. Moss's attention was directed to the meteor by its remarkable brightness, which he estimated as exceeding that of Jupiter. The part of the path that he observed was about 5° long, and commenced at a point near to the equator, and about 8° E. of δ Orionis. The same object was independently observed by Mr. Mills, who describes it as the brightest he has yet seen, and states that it first appeared about 5° due east of γ Orionis, and, travelling in a south-easterly direction, appeared to burst when approximately 8° or 10° to the N.E. of Rigel.

Several meteors, six of which were probably Leonids, were observed by Mr. W. E. Rolston at South Kensington during an intermittent watch which lasted from 10 p.m. on Saturday until 4.30 a.m. on Sunday. The brightest of the six was one which appeared at about 3.15 on Sunday morning in R.A. 7h. 10m. Dec. +6°, and disappeared at R.A. 6h. 30m., Dec. +5°, leaving behind it a green broken trail which lasted for about two seconds. The same observer also saw more than 50 Leonids during a watch from 2.15 to 3.45 on Monday morning. These meteors presented the characteristics of the November shower inasmuch as they were exceedingly swift and left broken trails of a reddish hue.

Mr. A. M. Davies, writing from Amersham, Bucks, states that about 10.45 p.m. on November 14 he saw a brilliant meteor with a train move westwards in an almost horizontal path at about the altitude of η Ursæ Majoris.

SEARCH-EPHEMERIS FOR FAYE'S COMET.—Herr E. Strömgren publishes a further portion of his ephemeris for Faye's comet in No. 3913 of the *Astronomische Nachrichten*. This ephemeris takes the time of perihelion passage as June 3·64, and is given below:—

Ephemeris 12h. (M.T. Berlin).

1903	α (h. m. s.)	δ (° ′)	log r	log Δ
Nov. 15	9 42 59	+1 45·0	0·3565	0·3288
,, 19	9 46 23	+1 11·5		
,, 23	9 49 25	+0 39·5	0·3655	0·3180
,, 27	9 52 3	+0 9·3		
Dec. 1	9 54 16	−0 19·0	0·3743	0·3067
,, 5	9 56 5	−0 45·1		
,, 9	9 57 29	−1 8·8	0·3830	0·2952
,, 13	9 58 26	−1 30·1		
,, 17	9 58 57	−1 48·7	0·3916	0·2840
,, 21	9 59 1	−2 4·3		
,, 25	9 58 38	−2 16·9	0·4000	0·2736

THE SECULAR VARIATION OF STARLIGHT.—In a research on the secular variation of starlight, that is, the minute yet regular variations in magnitudes which take centuries to become evident, Mr. J. E. Gore has compared the present magnitudes of a number of stars with their respective magnitudes as recorded by Al-Sufi and Ptolemy. Recognising the important bearing of these variations on the theory of stellar evolution, he selected a number of stars having spectra of the first and second types for the comparison, and has published the details of his research in the November number of the *Observatory*, giving in each case the type of spectrum, the recently estimated magnitude, and the magnitude as recorded by Al-Sufi and Ptolemy, together with remarks on the validity of the latter. Mr. Gore has prepared two lists, one of which contains the data concerning 20 stars which are apparently decreasing in magnitude; the other deals with 20 stars which show an apparent increase. He points out in his remarks that in many cases the stars which are decreasing in magnitude have spectra of Pickering's "A" type, which, according to Sir Norman Lockyer's classification, would place them amongst those which are decreasing in temperature, and therefore, presumably, in magnitude; a well-known example of this agreement occurs in the case of β Leonis, which, according to Sir Norman Lockyer, must be placed on the *descending* side of his temperature curve, and, according to Mr. Gore's result, has decreased in magnitude from 1·0 in Al-Sufi's time to 2·2 at the present day.

SOLAR OBSERVATIONS AT LYONS OBSERVATORY DURING 1902.—In his annual report for 1902, M. J. Guillaume, director of the Lyons Observatory, states that the solar surface was observed on 236 days during the year, and was reported as being free from spots on 161 days. Thirty-three groups of spots were observed, their mean latitude being 21°·0, an increase of 5°·3 over last year's value. According to the Lyons observations the last sun-spot minimum took place at the end of 1901.

The observations of faculæ show an increase in the number of groups, and the area covered by them, over the two preceding years; they also indicate that the mean latitudes of spots and faculæ do not show a parallel variation, and from this, and the differences exhibited in their persistence and activity, M. Guillaume arrives at the conclusion that it is really the faculæ which indicate the regions of principal activity, the spots being only of secondary importance in this matter. This conclusion is supported by the various tables which accompany the report in the November issue of the *Bulletin* de la Société de France.

METEOROLOGICAL OBSERVATIONS WITH KITES AT SEA.

THE following extracts from a communication to our contemporary *Science* by Mr. A. L. Rotch indicate the rapid progress which is being made in the exploration of the upper air by means of kites from ships, and a scheme for further investigation.

The first to repeat the pioneer experiments of the late Mr. Sweetland and the writer during their voyage across the North Atlantic in 1901 were Messrs. Berson and Elias, of the Prussian Meteorological Institute, who, last August, made a voyage from Germany to Spitzbergen and back, achieving satisfactory results with their kites. Meanwhile Prof. Köppen, of the Deutsche Seewarte, carried out analogous experiments on the Baltic Sea. About the same time, Mr. Dines, aided by grants from the Royal Meteorological Society and the British Association, employed a small steamer for kite-flying off the west coast of Scotland, in connection with a fixed station on land.

Meteorological kites have recently been flown from steamboats on Lake Constance by Count von Zeppelin and Prof. Hergesell on some of the term-days of the international balloon ascensions. Similar experiments upon the smaller lakes of Prussia and Russia have also shown that kites may be rendered nearly independent of the wind even in the interior of the continents.

A most remarkable campaign has been conducted by M. Teisserenc de Bort, who, with the aid of Scandinavian colleagues, established last summer a kite-flying station in Jutland, Denmark, where aërial soundings were made day and night, wind permitting, during nine months. After the termination of this work the apparatus was transferred to a Danish gunboat, and on a cruise in the Baltic Sea the following extraordinary results were obtained on five consecutive days:—April 22, at an altitude of 9450 feet a temperature of +14°.8 F. was found; April 23, at 13,500 feet, the temperature was 9°.1; April 24, at 4660 feet, 38°.3. On April 25 an altitude of 19,360 feet, which is probably the greatest height ever reached by a kite, was exceeded, and an instrument on the lower portion of the wire, at a height of 7415 feet, recorded 24°.4. In this flight the total length of the wire was 38,000 feet, and the upper 4000 feet, with the highest registering instrument, broke away, but were recovered. On the morning of April 26 an altitude of 8140 feet, with a temperature of 15°.2, was obtained, and in the afternoon 13,320 feet, with a temperature of 3°.2. Since the gunboat steamed only nine and a half knots, the kites could not be flown when there was a complete absence of wind.

These various experiments amply prove the practicability of the writer's project to investigate the atmospheric strata lying above the doldrums and trade-winds, by means of kites flown from a specially chartered steamship. This plan received the approval of the International Aëronautical Congress at Berlin last year, and an application for a grant to aid its execution is now before the trustees of the Carnegie Institution. On the vessel which the Baltimore Geographical Society sent last month to the Bahamas, Dr. Fassig, of the Weather Bureau, expected to fly kites, but, owing to the substitution of a schooner for a steamer, this could not well be done, and therefore the kites were probably flown only at Nassau. These observations might serve as a starting-point for the work of the expedition proposed by the writer, which would proceed across the equator and be capable of sounding the atmosphere to the height of four miles, notwithstanding the fact that winds either too light or too strong for the kites may be encountered when the steamer is stationary.

THE COUNTY TECHNICAL LABORATORIES, CHELMSFORD.

ESSEX is one of the counties which, since the passing of the Local Taxation (Customs and Excise) Act of 1890, has devoted the whole of the funds thus provided to the purposes of higher education. At first almost the entire grant was distributed among some forty local technical instruction committees for the purpose of lectures and classes in the areas under their supervision, but by degrees the greater part has been diverted to the erection, equipment, or support of secondary and technical schools in the more important centres.

In 1892, when Sir Henry Roscoe and Prof. Meldola were members of the Essex Technical Instruction Committee, the site of an old grammar school in the centre of Chelmsford—the county town—was purchased, and part of the old school buildings were fitted up at a cost of about 300*l.* as the county laboratories for teaching biology and chemistry, the two sciences which are of greatest importance to the principal industries of the county, viz. agriculture, horticulture, dairying and fisheries. In the temporary accommodation thus provided most of the work of the past ten years has been carried on, and readers of NATURE have from time to time had an opportunity of judging its character.

From the commencement until he was appointed agricultural biologist to the Irish Board of Agriculture in the spring of 1902, the committee had the advantage of the services of Mr. David Houston as staff-teacher of biology. Mr. Houston's influence was directed towards basing the teaching of science on practical laboratory work. It thus comes about that the institution has always been known as, and still remains, the Laboratories for Technical Instruction of the County of Essex. Moreover, the subcommittee, which now has the supervision of the laboratories, a committee which, with the single exception of the chairman, entirely consists of Essex farmers, adopted plans for the new buildings, opened by the President of the Board of Agriculture on October 30, which mainly consist of laboratories and work-rooms, and include only one lecture-room in the whole institution.

The part of the old site on which the new buildings are placed is within a stone's throw of the market-place and corn exchange, and the intention is to provide, not merely a technical school for the younger men, but also a centre at which farmers and others can readily obtain scientific and practical information respecting farming and the allied industries. Thus the principal room, near the entrance on the ground floor, is the large agricultural room, provided with demonstration and work tables for the agricultural instruction of students, and also containing an agricultural museum and reference library, together with diagram frames for displaying the most recent results of agricultural experiments. The room will be kept supplied with the agricultural papers, and will serve for the meetings of farmers which are held from time to time on market days to discuss agricultural problems.

On the same floor are the rooms for the head of the chemical and agricultural department, the work-room of the assistant who has the management of the field experiments, a small physical room with dark room for optical and photographic work, the common rooms for men and women students, and one of the biological laboratories.

On the first floor is a chemical laboratory capable of accommodating twenty students at a time; each working bench is provided with drawers and lockers for four sets of students, so that eighty students can be taught in a term. All the students' benches face the demonstration table, and thus the teaching can be carried on by revision, demonstration or experimental work without the students leaving their benches. Adjoining are the balance room and store room, the latter in direct communication with the chemical lecture room, and a private laboratory for the analysis of soils, manures, feeding-stuffs, milk, &c., for farmers, a department of the work which is found to be a most potent means for spreading information.

On the same floor are some of the rooms of the biological department, but shut off from the chemical department and reached by a separate staircase. Thus horticultural students, for whom the biological staff is responsible, are kept separate from the agricultural students, for whom the chemical staff is responsible. The common room for all the male students stands between the two departments. This system of separate staircases has the additional advantage of saving room, for a striking feature of the general plan is that there is only one corridor in the whole building. The biological department includes two large laboratories, each provided with a preparation or private work-room, a lecturer's private room, a store room, and museum galleries. The two laboratories each accommodate twenty students, and, as in the chemical laboratory, the working tables all face the demonstration table and black board.

A cool, lofty and well-lighted basement serves admirably for the dairy. The accommodation includes a milk receiving room, which it is proposed to equip with separator, pasteuriser, and steam apparatus for cleaning milk churns, &c., the dairy proper, with butter churns for twelve students, a cheese-making room, a cheese-ripening room and store. A top floor of six rooms is at present used as a part of the County Education Offices, but these are to be diverted to teaching purposes at the end of two years, when it is expected that the teaching or experimental work of the laboratories will demand increased space. The whole building is lit with electricity. The electric current is also used for motive power where required, and adapted to electrolytic purposes in the chemical and physical laboratories.

Within three-quarters of a mile of the laboratories is the school garden, which has already been planted about five years. It is three acres in extent, and is provided with a students' potting shed and glass houses, and consists partly of botanical plots and partly of fruit, vegetable and flower borders for the practical instruction of gardening students in each branch of horticulture. There is no farm in connection with the laboratories; the agricultural students make excursions to well-managed farms in the neighbour-

hood, and the field experiments are carried out on farms in all parts of the county, this system having the double advantage that manurial trials can be made on every class of land, and that farmers in each district are able to see for themselves the results.

THE NEWCOMEN ENGINE.[1]

A GREAT deal has been written on the steam-engine generally, but the author has not met with any connected record of the invention and construction of the first steam-engine—the atmospheric engine of Newcomen. Unfortunately it does not appear that very detailed information is available, but the author has been able to bring together some facts which, with the aid of appendices contributed by others and some illustrations of the engine itself, may be found to be a useful contribution to place on record in the *Proceedings* of the Institution. There are not many examples of the engine now in existence, and when they are consigned to the scrap heap, the receptacle of great efforts of the past, all will perhaps be forgotten.

Towards the end of the seventeenth century, philosophers and mathematicians searched for a new method of obtaining motive power. Mining was an important industry requiring in most cases a new power, that the mines might be worked to greater depths. Water-power, where available, was often insufficient, and manual and animal power was altogether too small and too expensive for working any but shallow mines. Deep mining was, and is, only possible with pumping machinery. Water-wheels were used for working pumps. The construction of the common pump was known. Papin had proposed to transmit power by means of pistons moving in cylinders acted on by the atmosphere, a vacuum having been formed under the pistons by the explosion of gunpowder, and he even hinted that it might be done by steam.

It was claimed for Papin that he invented the steam-engine, because in 1685, in one of his letters, he illustrated what was known of the properties of steam by saying that if water was put in the bottom of a cylinder under a piston, and the cylinder be put on a fire, the water would evaporate and raise the piston, and that if, after the piston had been raised, the cylinder were removed from the fire and cooled, the steam would condense and the piston would descend; but this was only an illustration of common knowledge. Sir Samuel Morland had, in 1683, stated[2] that steam occupied about two thousand times the space of the water from which it was produced, and made some calculations as to the powers to be obtained from different sized cylinders, but suggested no practical mode of operation. An experiment to determine the density of steam was made by John Payne in 1741. Payne concluded, as the result of his experiments, published in the *Phil. Trans.*, vol. xli. p. 821, that one cubic inch of water formed 4000 cubic inches of steam. Beighton calculated, from an experiment with the Griff engine, the second Newcomen engine erected, that the specific volume of steam was 2893.

The properties of steam were, probably, no better known to philosophers than to the ordinary observer who had seen the lid of a kettle dance under pressure, or steam issue from the spout. The only practical application of steam was made by Savery, who, in 1696, described his invention in a pamphlet entitled "The Miner's Friend." Savery's engine was a pistonless steam pump—in fact, the pulsometer of to-day without its automatic action. It remained for Newcomen to associate the bits of common knowledge in his mind for inventing the steam-engine. He was a blacksmith, probably accustomed to invent methods of construction in the prosecution of his art. At that time mechanics were more self-reliant than they are now. He knew from experience what a lever was, a pump, a piston, a cylinder, a boiler, and he knew that the atmosphere had pressure, and that steam possessed a far greater volume than the water which produced it. It did not require much more than common knowledge and observation to realise that. To produce the steam-engine from such known facts required invention. Philosophers probably knew what might be done, but Newcomen had the advantage of seeing what could be done, and he did it. The engine, when produced, was imperfect, but defects became obvious to the designers and constructor of steam-engines, and the want of perfection at the present day is not from want of theory, but because of practical limitations and want of practical invention.

At this distance of time it is difficult to appreciate the invention required to produce the atmospheric engine from the crude ideas of Papin and others. It appears, from papers in possession of the Royal Society, that Dr. Hooke had demonstrated the impracticability of Papin's scheme, and, in a letter addressed to Newcomen, advised him not to attempt to make a machine on that principle, adding, however, that if Papin could produce a speedy vacuum, his work would be done.[1] A great deal of controversy hangs about this as about all things historical, and little is to be gained by minute research into disputed claims. What we do with certainty know is that with the common knowledge existing, and the mechanical contrivances available, Newcomen alone succeeded in making a workable engine.

In 1698, Thomas Savery, of London, obtained a patent for raising water by the elasticity of steam.[2] It is stated in many popular histories that in 1705 Thomas Newcomen, John Cawley, of Dartmouth, and Thomas Savery, of London, secured a patent for "condensing the steam introduced under a piston and producing a reciprocating motion by attaching it to a lever," but no record of such a patent exists in the Patent Office. Stuart gives a list of patents commencing with 1698, and in that list is one said to have been granted in 1705. Dr. Pole, author of "The Cornish Engine," had a search made at the Patent Office and no such record could be found. It is possible that Savery's patent was thought to cover Newcomen's invention (as Savery was associated with Newcomen).[3] This was sixty-four years before Watt invented his separate condenser. Very little is known of Newcomen. It is recorded that he was a blacksmith or ironmonger residing at Dartmouth, in Devonshire, and that he was employed by Savery to do some work in connection with his water-raising engines. In this way he had some experience in the condensation of steam.[4]

Newcomen appears to have conceived the idea of using a piston for giving motion to pumps. He became associated with John Cawley, a glazier of Dartmouth, probably for business reasons. His connection with Savery was doubtless because of Savery's patent for condensing steam for raising water. He must, however, have been a good mechanic, because the construction of such an engine at a time when there was no previous experience or data to guide him was a task of no ordinary magnitude. He could not get workmen skilful enough to do his work until, erecting an engine near Dudley in 1712, he secured the assistance of mechanics from Birmingham.

The Newcomen engine was soon brought into use, for in 1712 Newcomen, through the acquaintance of Mr. Potter, of Bromsgrove, erected an engine, near Dudley Castle, for a Mr. Back, of Wolverhampton. The cylinder of this engine was surrounded with water. The piston was packed and had a water seal. It is reported that by accident a hole in the piston admitted water into the cylinder, and the condensation thereby became so rapid compared with that produced by cooling the cylinder from the outside that the engine worked much quicker. This may or may not be correct, but it is certain that, by accident or design, the first improvement in the engine was condensation by injection in the cylinder. It appears that the second engine was erected at the Griff Colliery, in Warwickshire, in 1715. It had a 22-inch cylinder. At this time the cocks and

[1] Abstract of a paper read before the Institution of Mechanical Engineers on October 16 by Mr. Henry Davey.

[2] See Tredgold's "Steam Engine."

[1] See Stuart's "History of the Steam Engine."

[2] Savery was born at Shilston, near Modbury, in Devonshire, in 1650; died in London 1715.

[3] It appears that there is every reason to believe that Newcomen had no patent, and that his invention was supposed to be covered by Savery's patent of 1698, and that the latter was kept in force for thirty-five years, the original patent having been extended for twenty-one years.

[4] Newcomen was born at Dartmouth about the middle of the seventeenth century, and died in London in 1729. It is stated in Haydn's "Dictionary of Dates" that at the time of his death he was in London trying to secure a patent. A sketch of the house in Dartmouth occupied by Newcomen when he invented the steam-engine is shown in a pamphlet published in 1869 for Mr. Thomas Lidstone of Dartmouth.

valves were all worked by hand, but automatic devices were soon introduced. The first appears to be that of actuating the injection-cock by means of a buoy in a pipe connected to the cylinder. Desaguliers thus describes the apparatus :—"They used to work with a buoy in the cylinder enclosed in a pipe, which buoy rose when the steam was strong and opened the injection and made the stroke." It is said that a boy, Humphrey Potter,[1] added a catch or "scoggan" which the beam opened, and by this means the speed of the engine was increased from 8 or 10 to 15 strokes per minute.

Barney's illustration of the Dudley Castle engine (erected in 1712) was made in 1719, and contains the plug-frame and tumbling-weight device attributed to the invention of Beighton in 1718. It is possible that the tumbling-weight had just been added for actuating the steam-valve. The injection-valve is released by the buoy said by Desaguliers to have been enclosed in a pipe attached to the cylinder, but here shown in a pipe attached to the boiler. The scoggan is also shown, and it is clear that the only thing that Humphrey Potter added, if he added anything, was a cord to cause the plug-frame to actuate the scoggan instead of the float doing it.

Newcomen had associated with him Cawley, a plumber and glazier, and it will be observed that the pipes of the engines were at first made of lead with plumber's joints. In the early days the steam cylinders only were obtained from iron-founders, and the other parts of the engine were built by local blacksmiths, carpenters, and plumbers, under the direction of an engineer.

The engine was first fixed on a boiler of haystack form, but the vibration of the engine so loosened the joints that it was found advisable to secure the cylinder to strong wooden beams above the boiler. At a later date the engine was fixed on a separate foundation by the side of the boiler, and as time went on iron pipes were substituted for lead, and the waggon-boiler was introduced to take the place of the haystack.[2]

Among the first erectors of the Newcomen engine were the Hornblowers, in Cornwall. Newcomen visited Mr. Potter, of Bromsgrove, and erected an engine near Dudley Castle in 1712. This is the historical engine in which injection in the cylinder was first used. In the vicinity lived Joseph Hornblower, an engineer who became acquainted with Newcomen's engine, and who was sent for into Cornwall about 1720 to 1725 to erect an atmospheric engine at Wheal Rose Mine, near Truro.

It may be interesting here to observe, on the authority of Cyrus Redding, a greatgrandson of Joseph Hornblower, and author of "Yesterday and To-day," &c., that the Newcomen engine was not such a simple machine as only to require the attention of boys as stated in popular histories, but that it required the united exertion of three men to start the engine.

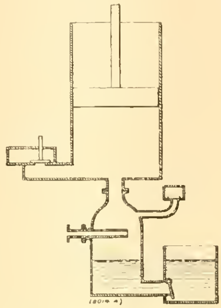
A second engine, it appears, was erected by Hornblower at Wheal Bury or Chasewater Mine. A third at Polgooth. Joseph Hornblower then left the county, and his son Jonathan came down and erected his first engine at Wheal Virgin, about 1743. The fourth son of Joseph was Jonathan Carter, the inventor of the compound engine and the double-beat steam-valves, who died at Penrhyn in 1815.

From 1720 to 1740 few engines were erected in Cornwall because of the high duty on sea-borne coal. In 1741 an Act of Parliament was passed for the remission of the duty on coal used for fire-engines for draining tin and copper mines in the county of Cornwall.[3] The effect of the passing of this Act was that by the year 1758 many engines had been brought into use; one engine at Herland had a 70-inch cylinder.

Rotative Atmospheric Engines.—It appears that attempts were made as early as 1768 to produce a rotative motion from a Newcomen engine, but it was not until about 1780 that it was successfully accomplished by the use of the crank.

It does not appear that any attempt was made, before Watt's separate condenser was invented, to reduce the cooling effect of the injection-water on the cylinder by effecting the condensation in a small vessel attached to the cylinder. It is, however, evident that after Watt's patent, Newcomen engines were made with separate condensers without air-pumps, the air being discharged through a snifting-valve. Such condensers were known as "pickle-pots."

FIG. 1.



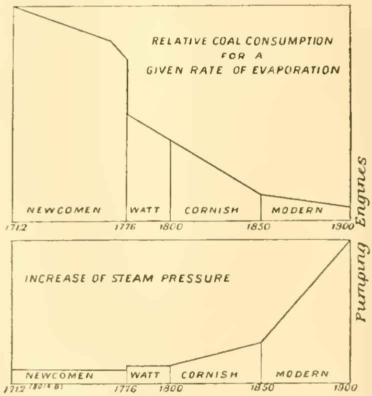


FIG. 2.

Diagrams illustrating the progress in economy of fuel and the increase of steam pressure.

In Fig. 1 will be found a sketch of the "pickle-pot" condenser. Such condensers were operated without air-pumps, as already described. It is more than probable that such condensers were not known until after Watt's invention of the separate condenser, and that they were applied to improve the economy of the Newcomen engine and to evade Watt's patent.

In Fig. 2 will also be found a diagram constructed by the author to indicate the economy of fuel resulting from various improvements commencing with the earliest engines of Newcomen. A diagram below also indicates

[1] It is curious to observe that the first engine was erected for Mr. Back through the influence of a Mr Potter. Mr. Norris writes that John and Abraham Potter were engineers in Durham, and erected an engine for Mr. Andrew Wauchope in Midlothian in or about 1725. See also Bald's "View of the Coal Trade of Scotland," pp. 18, &c., for a full account of this engine. He prints the contract in full, giving many interesting details.

[2] A drawing of almost the first Watt engine for the Birmingham Canal was illustrated in the *Engineer*, July 15, 1898. This is now erected in the yard at Ocker Hill, near Wednesbury.

[3] The Act referred to is the 14th Geo. II., Cap. xli., and intituled :—An Act for granting to His Majesty the sum of one million out of the sinking fund, and for applying other sums therein mentioned for the service of the year 1741; *and for allowing a Draw-back of the Duties upon Coals used in Fire Engines for drawing Tin and Copper mines in the County of Cornwall, &c* . . .

the rise in steam pressure corresponding to the increased economy.

The steam-engine has held its own as a prime mover for two centuries. The gas-engine has now become a more efficient heat engine, and a powerful competitor, and electricity has become an economical transmitter of power.

Heat, electricity, and mechanical work are mutually convertible. The time may come when heat may be converted into electric current with as little loss as that involved in the conversion of electric current into mechanical work; when that time comes, the heat efficiency of the prime mover will exceed that of the gas-engine in a greater degree than the gas-engine has exceeded that of the steam-engine.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

Cambridge.—The Public Orator, Dr. Sandys, of St. John's College, spoke as follows in presenting, for the complete degree of Master of Arts *honoris causa*, Mr. Howard Marsh, recently elected professor of surgery in succession to Sir George Humphry, who died in 1896.

Haud ita pridem, ut meministis omnes, plenus annis, plenus honoribus, e vita excessit vir insignis, per annos plurimos primum anatomiam, deinde chirurgiam, inter nosmet ipsos praeclare professus. Qui qualis quantusque vir fuerit, quanto scientiae amore, quanta animi alacritate, quanta sermonis facundia praeditus, non est quod longius exsequar: vosmet ipsi vobiscum recordamini. Chirurgiae vero professoris nostri primi in locum, annorum septem intervallo interposito, nuper electus est vir egregius, quem, tot aliis ministrum salutis, Academiae nomine hodie ipsum jubemus salvere. Viri talis autem inter laudes, non nostrum erit hodie scientiae tam reconditae penetralia perscrutari, non artis intimae mysteria occulta et abstrusa in lucem proferre; ne corporis quidem mala illa dura verbis duris expressa, ut ἀρθρῖτις, ut ἀγκύλωσις, totiens ab hoc viro feliciter levata, coram vobis hodie commemorabuntur. Mentis potius ad bona praeclara transibimus, et professorem nobis nuper datum propterea praesertim animo laeto accipiemus, quod ingenio tam vivido, judicio tam subacto est praeditus, in rebus minutissimis observandis tam subtilis, in rebus obscurissimis explicandis tam lucidus. Viro in ea parte medicinae quae manu curat insigni manus libenter tendimus, dextraeque tam sollerti dextram libenter jungimus. Duco ad vos baronetti quidem illustris, Jacobi Paget, quondam adjutorem, equitis autem insignis, Georgii Humphry, nunc demum successorem, virum nobis omnibus acceptissimum, Professorem Marsh.

A special course of advanced lectures on certain general aspects of zoology, to be given at the zoological laboratory during the Michaelmas and Lent terms, on Tuesdays and Saturdays at noon, commenced on November 17. The course includes lectures by the following:—Mr. Brindley, regeneration; Mr. Doncaster, (1) Weismann and his work, (2) experiments with Echinoderm eggs and larvæ; Mr. Fletcher, cell-structure, cell-division and maturation of germ-cells; Mr. J. S. Gardiner, marine fauna; Mr. Hopkins, animal pigments; Mr. Punnett, metamerism; Mr. Shipley, parasites. The first two lectures are on parasites, by Mr. Shipley. The order of the other lectures will be arranged later.

Mr. Bertram Hopkinson, son of the late Dr. John Hopkinson, F.R.S., has been elected professor of mechanism and applied mechanics in succession to Prof. Ewing. Prof. Hopkinson was placed in the first division of the first class of the mathematical tripos, part ii., in 1895, and was *proxime accessit* for the Smith's prizes in 1896.

Mr. W. Morley Fletcher, Trinity, has been appointed demonstrator of physiology.

A Clerk Maxwell studentship for research in physics will be filled up at the end of this term. Applications are to be sent to Prof. J. J. Thomson by December 18. Candidates must have worked at least one term at the Cavendish Laboratory.

The special board for medicine proposes to establish a post-graduate examination and diploma in tropical medicine and hygiene, intended to meet the needs of military, colonial, and missionary practitioners. Mr. Chamberlain and Mr. Brodrick have expressed their approval of the proposal in the interest of the imperial medical services.

A syndicate consisting of Dr. Guillemard, Dr. A. Macalister, Dr. Haddon, Prof. Ridgeway, Mr. J. G. Frazer, Mr. A. E. Shipley, Mr. W. L. H. Duckworth, and Dr. Rivers, is proposed to consider the better organisation of the study of anthropology in the University.

The Advisory Board on Military Education and Training, appointed by the Secretary of State for War in April last, has stated some of the conclusions which have been arrived at, and now carry the approval of the Secretary of State. With regard to the selection of the candidates for commissions through Sandhurst and Woolwich, it is proposed to subject them to a twofold test, consisting of a preliminary qualification and a competitive examination. The Advisory Board is of opinion that the subjects covered by the qualifying certificate (which is to be given not by a special examination, but some substitute in the shape of a "leaving certificate") must include:—(1) English; (2) history and geography; (3) mathematics (elementary); (4) French or German; (5) either (*a*) Latin or Greek, or (*b*) science. By "science" in this scheme is meant such combination of experimental or natural sciences as the Board may approve. Provided always that the sciences recognised shall have been taught in a sufficiently extended course, say three years, involving a sufficient amount of laboratory or field work. In the competitive examination the Board considers that for Woolwich candidates it should consist of three compulsory subjects, viz. English, either French or German, mathematics i., and of any two out of the following:—mathematics ii., science, history, French, German, Latin, Greek. For Sandhurst candidates they propose that there should be two compulsory subjects, viz. English, and French or German, with any two of the following:—mathematics i., mathematics ii., science, history, French, German, Greek, Latin. It consequently seems possible, and in view of public school traditions highly probable, that we may have young officers in training under the new regulations who are completely ignorant of scientific method.

Some severe criticisms of our system of education for officers in the Army were made by Lieut.-Colonel F. N. Maude at the Royal United Service Institution last week in a lecture on "Military Education." He remarked that the rising generation of young officers as a body were leaving the public schools with less education than that of many of our rank and file. In his experience, Militia, Sandhurst, and Woolwich candidates were all willing to learn, and were easily interested in their work for a time, but as a body they were mentally incapable of "concentration" for more than a few minutes. He suggested that the Government should appoint a committee of the highest specialists in nervous diseases, loss of control, and similar troubles, and get them to report on the psychological, not the physiological, influence of "drill" exercises in restoring and developing will-power in the individual. Having secured concentration, what were they to teach? Primarily, they needed the power to observe facts accurately—*i.e.* scientific teaching; next, the knowledge of facts previously registered—*i.e.* history; and, thirdly, the power to reason accurately from given data—*i.e.* mathematics. But neither history nor science could be studied without a knowledge of modern languages. History was unintelligible without physiography, geography, and topography—hence these subjects should form integral parts of its teaching. Let the Government, he said, settle a course of instruction which could only be accomplished in the time by concentration of purpose on the decisive factors, and would require in every school a thoroughly modern equipment of educational means and appliances, and, to start the system, let it send its own experts round to advise and assist headmasters. In conclusion, he strongly urged the importance of securing for the Army a good supply of older university and Militia candidates, men who joined the service not only with a fuller sense of responsibility than one found in the average schoolboy, but also with a far wider and surer basis of knowledge.

UNDER the joint auspices of the Technical Education Board of the London County Council and of the Geographical Association, two conferences will be held on Thursday, January 7, 1904, in the South-western Polytechnic, Manresa Road, Chelsea. In the morning, at 11 o'clock, Mr. H. J. Mackinder, reader in geography at Oxford, and the appointed teacher of geography in the University of London, will open a discussion on the development of geography out of nature-study. In the afternoon practical methods of teaching geography will be dealt with. Mr. Lomas, of Liverpool, will take up the question of teaching geography by excursions; Mr. T. Alford Smith, St. Dunstan's College, Catford, will describe a method of using the globe and lantern views; Mr. P. F. Kendall, of the Yorkshire College, will discuss methods of making and using models; and Mr. A. J. Herbertson, of the Oxford University School of Geography, will advocate the employment of Ordnance maps in teaching geography, and will, in particular, deal with sheets which are illustrative of typical land forms. In connection with these conferences an exhibition of geographical appliances, maps, and books of use to teachers will be arranged. It will probably be open from Tuesday, January 5, to Saturday, January 9, at the South-western Polytechnic. The Geographical Association has appointed a special committee to select exhibits.

LORD KELVIN on November 13 received the honorary degree of D.Sc. from the University of Wales. On the evening of the previous day he received the honorary membership of the South Wales Engineers' Institute, and in expressing his thanks for the honour, he remarked that engineers all over the world had still a good deal to learn as to the real value of university training. In the matter of the education of foremen in engineering works the Germans had learned how to give them scientific knowledge in a way in which we in England had not given it. It was necessary for the young engineer to learn the practical as well as the theoretical, and this could only be accomplished satisfactorily by the student's spending half his year at the university and half in the workshop, where he might learn to apply the scientific knowledge which he had acquired in the university.

AT the Sir John Cass Technical Institute, Aldgate, on Tuesday, November 17, the prizes and certificates gained by students during the past session were distributed by Sir Henry Roscoe. The institute is one of the polytechnics aided by the Technical Education Board of the London County Council and by the City Parochial Foundation. In addition to general instruction in the experimental sciences, art, commercial subjects, and domestic economy, special attention is given to the study of metals both from the scientific and the artistic side. Sir Henry Roscoe, in addressing the students, said that he hoped all present would agree with him that enough had been said about the value of the application of the principles of science and of art to industry, and that the time for work had come. Over and above the ordinary courses of instruction it is of the utmost importance that the higher work of students, especially research work, should be encouraged. What original work teaches is—how to overcome difficulties, how to obtain a mastery over opposing forces, how, in fact, successfully to tackle new problems when they present themselves, as they are ever doing to those who have eyes to see. Without this capability a man can only run in the beaten track, with it he has a weapon in his hand which gives him power to strike out new paths and to open up fresh and fertile ground. As in the scientific sphere, so also in the domain of art—the same guiding spirit holds the fort. Taste needs refinement, hand and eye require training, the craftsman, like the man of science, must be imbued with the spirit of progress as well as with a love of his art. Referring to the relation between the London University and polytechnics as regards internal students, Sir Henry Roscoe remarked that instruction given in the polytechnics must be of a real university type. It would be fatal to the prestige of the university were its necessarily high standard of efficiency lowered to meet the exigencies of the case. The course of study must be an extended one, as the hours devoted to work in the evening are necessarily shorter than those in the day; but the total time spent in study must be the same for both day and evening students, though a substantial reduction in time has been granted to those regularly employed during the day.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society.—"The Vapour Pressure of Liquid Oxygen on the Scale of the Constant-volume Oxygen Thermometer filled at different Initial Pressures." By Dr. Morris W. **Travers** and Dr. Charles J. **Fox.** Communicated by Sir William Ramsay, K.C.B., F.R.S. Received June 26.

The vapour pressures of liquid oxygen and of liquid hydrogen on the scales of the constant-volume hydrogen and helium thermometers have recently been determined by one of us in conjunction with Dr. A. Jaquerod and Mr. G. Senter, and it has been found that two scales of temperature differ by amounts which increase as the temperature falls (*Phil. Trans.*, A., vol. cc.).

	Vapour pressure	Hydrogen scale	Helium scale
Liquid oxygen	760 mm.	90°·10	90°·20
Liquid hydrogen ...	760	20·22	20·41

These results are in accordance with Callendar's calculations of the deviation from the thermodynamic scale of measurements with thermometers filled at an initial pressure of 1000 mm. of mercury at the melting point of ice. Whether the deviation becomes smaller when the thermometers are filled at a lower pressure has not been determined, and, indeed, with the means at our disposal it would be practically impossible to do so. In order, therefore, to investigate the variation of the readings of the gas thermometer with change of initial pressure, we decided to measure the vapour pressures of liquid oxygen on the scales of the constant-volume oxygen and nitrogen thermometers, for which the deviations from the thermodynamic scale are considerably greater.

Makower and Noble, using the method of Travers and Jaquerod, have found that the pressure coefficient of oxygen at an initial pressure P_o may be expressed by the formula

$$\alpha = 0{\cdot}0036642 + 0{\cdot}00000001457\ P_o,$$

where P_o is expressed in millimetres. Values derived from this expression were employed in calculating the temperatures corresponding to the vapour pressure of liquid oxygen on the scale of the oxygen thermometer filled at different initial pressures.

The results are stated in the following table:—

Gas in thermometer	Pressure on gas in thermometer at ice point	Pressure coefficient	Boiling point liquid oxyge
Helium	1000 mm.	0·00366255	90·20
Oxygen	1000	0·0036788	88·7[1]
	731	0·0036748	89·02
	658	0·0036738	89·09
	484	0·0036713	89·31
	336	0·0036692	89·48
	0	0·0036642	99·8[1]

[1] By extrapolation.

The results show that for very low pressures in the thermometer the oxygen scale converges towards the helium scale. The fact that the deviation does not appear to vanish at low pressures may be due to a tendency on the part of the gaseous molecules to associate at higher pressures

Mathematical Society, November 12.—Prof. H. Lamb, president, in the chair.—The council and officers for the ensuing session were elected. They are as follows:—president, Prof. Lamb; vice-presidents, Prof. Elliott, Dr. Hobson, Dr. Baker; treasurer, Prof. Larmor; secretaries, Prof. Love and Prof. Burnside; other members of council, Mr. Campbell, Dr. Glaisher, Mr. Grace, Mr. Macdonald, Major MacMahon, Mr. Mathews, Mr. Western, Mr. Whittaker, Mr. A. Young.—The following papers were communicated:—Prof. J. D. **Everett,** Note on Borgnet's method of dividing an angle in an arbitrary ratio. The method, which depends on the construction of a certain transcendental curve, was given by Borgnet in *Rouen. Acad.*

Travaux, 1839.—Prof. A. E. H. **Love**, The propagation of wave-motion in an isotropic elastic solid medium. The chief object of the paper is to remove a difficulty in Stokes's memoir on the dynamical theory of diffraction. Stokes's theory was built upon certain expressions for the cubical dilatation and the components of rotation, but these expressions are not always correct. A new foundation is now obtained for the theory in an independent investigation of the effects produced by force applied at one point. A knowledge of these effects renders possible the solution of a number of problems relating to wave-motion in an isotropic elastic solid, among them being the problem discussed by Stokes of the effects of arbitrary initial disturbances. It is proved that, unless certain relations connect the initial velocity and initial strain at points on the boundary of the portion of the medium which is disturbed initially, the strain in the neighbourhood of the centres of principal curvature of this surface will tend to become infinite, and fracture of the material will be produced.—Mr. H. **Hilton**, On spherical curves. The paper contains a general discussion of the curves on a sphere formed by the intersection of the sphere and any other algebraic surface.—Mr. W. H. **Young**, On sequences of sets of intervals containing a given set of points. A set of points being taken, intervals are constructed so that each interval has one of the points as an internal point, and the lengths of the intervals are diminished without limit. The author discusses the nature of the aggregate of points which throughout the limiting process remain internal points of the intervals.—The Rev. F. H. **Jackson**, A formal generalisation of Maclaurin's theorem.—Dr. H. F. **Baker**, On the Weddle quartic surface. Of the quadric surfaces which pass through six given points, those which pass through a seventh point pass also through an eighth; when these two coincide they must lie on a locus which is the surface under discussion. There is a birational relation between this surface and Kummer's sixteen-nodal quartic, and this relation is interpreted as a linear projection in space of four dimensions. From any point of Weddle's surface there can be derived by linear projections in three dimensions a remarkable figure of 32 points lying on the surface, and the formulæ by which the coordinates of these points are connected with those of the first point constitute an Abelian group.—Mr. W. H. **Jackson**, The theory of diffraction.—Mr. G. H. **Hardy**, A general theorem concerning absolutely convergent series.—Prof. R. W. **Genese**, Notes on quaternions, including a geometrical interpretation of $V\alpha\beta\gamma$.—Mr. E. T. **Whittaker**, On the expression of the electromagnetic field by means of two scalar potential functions. It is shown that the electric displacement and magnetic force due to any system of moving electrons can be expressed by second derivatives of two scalar potential functions.—Mr. P. W. **Wood**, Analogue of the Jordan lemma for four variables.

Entomological Society, October 21.—Prof. E. B. Poulton, F.R.S., president, in the chair.—Mr. J. H. **Keys** sent for exhibition a black variety of *Carabus nemoralis*, Müll., from Dartmoor.—Mr. G. C. **Champion** exhibited a series of *Rosalia alpina*, Linn., found by himself on old beech trees at Moncayo, north Spain, in July last.—Mr. A. J. **Chitty** exhibited a larva of *Dytiscus flavescens*, taken at Eastling, Kent, near the school buildings.—Colonel J. W. **Yerbury** exhibited *Gastrophilus nasalis*, Linn., taken at Torcross, Devonshire, from August 19 to 31 last. He said that as this rare species differs in a marked degree in its mode of flight, &c., from the common horse bot-fly, *Gastrophilus equi*, it would be as well to direct attention to these differences. *Gastrophilus equi*, when flying round a horse, visits as a rule the belly and the forelegs. The ♀ carries her ovipositor almost horizontal, and she looks, when on the wing, like the lower two-thirds of the letter Z (*L*), *G. nasalis*, on the other hand, carries the ovipositor tucked under the belly and almost parallel to the axis of the body; this gives her, when on the wing, a peculiar ball-like appearance; *G. nasalis*, too, always flies to the horse's head. As a rule, the horse paid no attention to *G. equi*, but *G. nasalis* caused him great alarm. The eggs of *G. equi* were in hundreds on the shoulders and forelegs of one cart-horse, but although the face and nostrils were searched carefully no signs of eggs or larvæ could be found thereon. Exhibiting *Chersodromia hirta*, Walk., he said these little Empids were common on the shore near Prawle Point; some were obtained by sweeping over seaweed, while others were running about over the sand. Colonel Yerbury also exhibited *Pamponerus germanicus*, Linn., from Barmouth and Porthcawl. He said this rare species appears to be struggling to keep its place in the British list. It appears to frequent the marram grass on the sand hills, and a ♀ taken at Barmouth on June 27 was preying on a beetle.—Mr. A. H. **Jones**, Mr. H. **Rowland-Brown**, Dr. T. A. **Chapman**, and Mr. R. W. **Lloyd** exhibited specimens of the genus Melitæa from various European localities. A discussion on the probable affinities of the several named species which occur in the Alps took place.—The president also exhibited some forms of *M. aurinia* taken by Mr. A. H. **Hamm** at Basingstoke and elsewhere, and forms of *M. athalia*, *M. didyma*, and *M. phoebe* from Asia Minor and Persia.—Dr. T. A. **Chapman** exhibited an album showing a series of photographs of the development of the embryo within the egg of *Psammotis hyalinalis* taken by Mr. W. H. Hammond and Mr. W. R. Jeffrey.—The president read, and commented upon, a paper received by him on protective coloration in its relation to mimicry, common warning colour, and sexual selection, by Mr. Abbot H. **Thayer**.

Zoological Society, November 3.—Dr. W. T. Blanford, F.R.S., vice-president, in the chair.—Dr. W. B. **Benham** communicated a memoir dealing with the aquatic Oligochæta of New Zealand.—Mr. Oldfield **Thomas** read a paper on the mammals collected at Chapadá by Mr. A. Robert during the Percy Sladen Expedition to Central Brazil, and presented to the National Museum by Mrs. Percy Sladen. No modern specimens had hitherto been obtained from this little-known region. Thirty-seven species were enumerated, four of which were described as new.—Accounts were also given of the Coleoptera by Messrs. C. J. **Gahan** and G. J. **Arrow**, and of the Lepidoptera by Mr. F. A. **Heron** and Sir George **Hampson**, Bart., collected during the Percy Sladen Expedition. The former contained an enumeration of 175 species, of which fifteen were described as new, while the latter gave a list of nineteen species, one of which was described as new.—Prof. B. C. A. **Windle** and Mr. F. G. **Parsons** communicated a paper on the muscles of ungulates; in it the muscles of the hind limb and trunk were discussed.—Dr. P. Chalmers **Mitchell** read a note on the distribution of the cypriote spiny mouse. Specimens of this form, recently described as a new species (*Acomys nesiotes*) by Miss Bate, had been presented to the Gardens, and their localities showed that this mouse extended practically all over Cyprus.—Mr. F. E. **Beddard**, F.R.S., read a paper on some points in the anatomy, chiefly of the heart and vascular system, of the Japanese salamander (*Megalobatrachus japonicus*).

Anthropological Institute, November 10.—Mr. H. Balfour, president, in the chair.—Dr. F. W. **Edridge-Green** exhibited a collection of pictures painted by colour-blind persons. Dr. Green divided the colour-blind into two distinct, independent, but associated classes. The first class consisted of persons with a spectrum shortened at one or both ends, who consequently cannot see certain rays. An individual with a shortening of the red end would not be able to see a red light at a distance, although he could pick out all the pieces in a bundle of coloured wools. The second class made mistakes through their inability to recognise the difference between certain colours. Normal sighted persons see six colours, some even seven; the second class of the colour-blind see five, four, three, two, or one colour, according to the degree of their defect, and are called pentachromic, tetrachromic, &c.—The president, on behalf of Mr. **Annandale**, read a paper on the survival of primitive implements in the Færöes and Iceland, and illustrated the paper with an exhibition of many of the implements alluded to. These included bone skates, a shovel made out of the bone of a whale, a stone lamp, and stone hammers. In the discussion which followed, the great importance of collecting these primitive implements before they entirely vanish with the advance of civilisation was insisted upon.

PARIS.

Academy of Sciences, November 9.—M. Albert Gaudry in the chair.—On the storage of the *n*-rays by certain bodies, by M. R. **Blondlot**. The rays from various sources of light, after being filtered through an aluminium screen, possess the property of increasing the luminosity of a feebly phosphorescent screen. It was noticed when a quartz lens was used that this effect continued after the source of light, an incandescent mantle, was extinguished, and it was then found that quartz, Iceland spar, fluorspar, and various other substances possessed the same property. The rays are stored throughout the whole mass, and take some time to penetrate.—On the determination of invariant figures of cyclic transformations, by M. **Rabut**.—On the approximation of functions by quadratic surds, by M. S. **Pincherle**.—Generalisation of the fundamental property of potential, by M. A. de **Saint-Germain**.—On the laws of displacement of chemical equilibrium, by M. E. **Ariès**.—The dielectric cohesion of gases at low temperatures, by M. E. **Bouty**. The dielectric cohesion of a gas at constant volume is constant to within one per cent. for temperatures between $-100°$ C. and $+200°$ C.—On a practical solution of the problem of photometry of lights of different colours, by M. Charles **Fabry**. The method involves the use of a secondary standard of the same colour as the light to be measured. For this standard, the use of a flame is recommended with two coloured solutions of definite composition.—On the scintillation of phosphorescent zinc sulphide, in presence of radium, revivified by electric discharges, by M. Th. **Tommasina**.—Remark on the latest group of solar spots and the magnetic disturbances, by M. F. **Quénisset**. Photographs of the spots taken on October 31, the date of the magnetic storm, show that the area of the sun-spots was only one-third of the area of the spots on October 11, but that on October 31 the spots were accompanied by enormous faculæ, and hence the magnetic disturbance is probably to be attributed to the latter.—On the transparency of the sea, by M. **Thoulet**. A simple relation is given between the distance, y, at which a white circle on a black background just disappears, and the amount of solid matter in suspension, x, xy being constant. The relation has been applied to the determination of the weight of the sediment in suspension in sea water.—The use of balloons containing a subsidiary air balloon according to the theory of General Meusnier, by M. Henry de la **Vaulx**. An account of two voyages in a balloon fitted with small air balloons, the latter possessing independent valves, and with a rain shield. The device of a subsidiary air balloon, suggested by General Meusnier in 1783, was found to be of great practical value. The balloon is easily kept below the clouds, and a great saving of ballast is effected, rendering longer voyages practicable.—The conditions of separation of iodine in the form of cuprous iodide, in a mixture containing alkaline chlorides, bromides, and iodides, by MM. H. **Baubigny** and P. **Rivals**. The separation is effected by an excess of copper sulphate, in the presence of an alkaline arsenite and a little ferrous sulphate.—The action of organo-magnesium compounds upon acetol and its esters, by M. André **Kling**. In no case was any haloid organic compound formed, hence, comparing with the corresponding reaction with ethylene oxide and epichlorhydrin it follows that acetol and its esters behave as ketonic compounds, and as internal ether oxides of the ethylene oxide type.—The evolution of the compound Ascidians, by M. Antoine **Pizon**.—On the regeneration in Amphibia of the posterior members and the tail, in the absence of the nervous system, by M. P. **Wintrebert**. The regeneration of the limbs is not dependent on the nervous system.—Study of the digestive ferments in some invertebrates, by M. Victor **Henri**. A comparison of the activity of the amylolytic and proteolytic ferments of *Octopus vulgaris*, *Sepia officinalis*, *Spatangus purpureus*, and *Salpa africana* with the activity of the corresponding ferments from the dog.—A new hybrid obtained by grafting, by M. Lucien **Daniel**.—On the extra floral nectars of Hevea, by MM. Aug. **Daguillon** and H. **Coupin**.—Cytological researches on *Galactinia succosa*, by M. R. **Maire**.—On the oxidation of glucose in the blood, by M. L. **Jolly**. Alcohol exists naturally in ox blood, in very minute proportion, a portion of which is further oxidised in the blood to acetic acid.

DIARY OF SOCIETIES.

THURSDAY, NOVEMBER 19.

ROYAL SOCIETY, at 4.30.—The Physiological Action and Antidotes of Colubrine and Viperine Snake Venoms: Dr. L. Rogers.—On the Rapidity of the Nervous Impulse in Tall and Short Individuals: Dr. N. H. Alcock.—Electrometer Records of Secreto-motor Changes: Dr. A. D. Waller, F.R.S.—On the Nematocysts of Aeolids: G. H. Grosvenor.—The Cell Structure of the Cyanophyceæ: H. Wager.

LINNEAN SOCIETY, at 8.—A General View of the Genus Pinus: Dr. Maxwell T. Masters, F.R.S.—Contributions to the Embryology of the Amentiferæ. Part II.—*Carpinus Betulus*, Linn.: Miss Dr. M. Benson and Miss Elizabeth Sanday.

FRIDAY, NOVEMBER 20.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—Roofing Existing Shops while Work is Proceeding: R. H. Fowler.—Experiments on the Efficiency of Centrifugal Pumps: Dr. Thomas E. Stanton.

MONDAY, NOVEMBER 23.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—Recent Exploration and Economical Development in Central and Western China: Lieut.-Colonel C. C. Manifold.

SOCIETY OF ARTS, at 8. The Mining of Non-Metallic Minerals: Bennett H. Brough.

TUESDAY, NOVEMBER 24.

ANTHROPOLOGICAL INSTITUTE, at 8.15.—An Engraved Tablet from Easter Island: O. M. Dalton.—The Early Pot Fabrics of Asia Minor: J. L. Myres.

INSTITUTION OF CIVIL ENGINEERS, at 8.—On the Distribution of Mean and Extreme Annual Rainfall over the British Isles: Dr. H. R. Mill.

WEDNESDAY, NOVEMBER 25.

SOCIETY OF ARTS, at 8.—The Universal Exposition at St. Louis, U.S.A., 1904: George F. Parker.

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THURSDAY, NOVEMBER 26, 1903.

RECENT BOOKS ON NATURAL HISTORY.

Turner on Birds. A Short and Succinct History of the Principal Birds Noticed by Pliny and Aristotle. First published by Doctor William Turner, 1544. Edited, with Introduction, Translation, Notes, and Appendix, by A. H. Evans, M.A. Pp. xviii+223. (Cambridge: At the University Press, 1903.) Price 6*s.* net.

Among the Waterfowl. (The Dainty Nature Series.) By Herbert K. Job. Pp. xxi + 224; illustrated. (London: Wm. Heinemann, 1903.) Price 5*s.* net.

Nature Biographies. (The Dainty Nature Series.) By Clarence Moores Weed. Pp. x+164; illustrated. (London: Wm. Heinemann, 1903.) Price 5*s.* net.

The Brook Book. (The Dainty Nature Series.) By Mary Rogers Miller. Pp. xvi+241; illustrated. (London: Wm. Heinemann, 1903.) Price 5*s.* net.

The Waterfowl Family. By L. C. Stanford, L. B. Bishop, and T. S. Van Dyke. Pp. x+598; illustrated. (New York: the Macmillan Company; London: Macmillan and Co., Ltd., 1903.) Price 8*s.* 6*d.* net.

Handbook of Nature Study. For Teachers and Pupils in Elementary Schools. By D. Lange. Pp. xvi + 329; illustrated. (New York: the Macmillan Company; London: Macmillan and Co., Ltd., 1901.)

WILLIAM TURNER, whose strong religious opinions entailed for him a life of many vicissitudes in the days of Henry VIII. and his three successors, had also the makings of a good ornithologist. In his voluntary and enforced absences from England (during which he visited many European countries, and formed a friendship with Conrad Gesner), as well as in his travels in this country, he gained a knowledge of the appearance and habits of many birds which might have enabled him to write a book on the subject which would have been of surpassing interest at the present day. But, like some modern ornithologists, he was more concerned in finding out (often with doubtful success) to what species of birds certain names used by certain ancient authors really applied. So that when in 1544 he published his work on ornithology, his object was primarily to determine the principal kinds of birds named by Aristotle and Pliny.

Fortunately, however, Turner could not wholly restrain his natural bent for original observation, and here and there he added notes from his own experience, some of which form priceless items in the history of the birds of this country. In so doing (as the editor remarks) he produced the first book on birds which treats them in anything like a modern scientific spirit. He usually tells us whether he observed the various species in England or abroad, and thus Turner may fairly be called the father of British ornithology. To him we owe our knowledge of the fact that the crane bred in English fens, while his account of the abundance and audacity of the kite in his day reminds us how easy it would be to increase the remnant of these birds left to us by merely letting them alone. On the other hand, he tells us that the stork was nowhere to be seen in our island. He gives a sufficient answer to those extreme bird-protectionists who contend that the hoopoe was once abundant here and has been exterminated, for he knew the bird well, and states roundly that nowhere in the whole of Britain is the upupa to be found. His knowledge of the habits of various birds, such as the hobby, harrier, dipper, peewit, black tern and grey shrike (which he had seen not oftener than twice in England, though most frequently in Germany) is remarkable.

Turner's treatise has long been a great rarity, and ornithologists are much indebted to the editor and to the Syndics of the Cambridge University Press for making this early bird-book generally accessible.

In an appendix some extracts from a work by John Caius (1570) are added, which show that Caius was a good observer. It is interesting to note that the great rook controversy was precisely in the same condition in the sixteenth century as it is now, and that young rooks were even then appreciated.

The binding, printing, and illustrating of the "Dainty Nature Series" justify its title, although the highly-glazed paper rendered necessary for the reproduction of the numerous photographic illustrations makes the volumes very heavy to hold. Mr. Job relates his personal observations during five-and-twenty years in pursuit (chiefly with a camera) of the ducks, geese, grebes, divers, gulls, petrels, and other seafowl found in the northern and middle States and in Lower Canada, east of the Rocky Mountains. His charming work contains more new and original notes on these birds (both while at their breeding stations and in their less known winter haunts far from the shore) than any other book of this kind we have had the pleasure of reading. The illustrations are in advance of anything else of this kind we have seen. With photographs of nests and eggs we are now familiar. The present series is beautifully done, those of the ducks showing even the pattern of the "down." But it gives us a far better idea of the breeding habits of these birds when we have a view of a huge marshy sheet of water in the Magdalen Islands, where wildfowl breed in crowds; and a bit of a "slough," showing the identical clump of rushes which hides a canvas-back duck's nest, really tells us more of the bird's life-history than a picture of the actual nest and eggs. Again, the author has obtained pictures at close quarters of gulls, guillemots, &c., on or alighting at their nests. As examples of what may be found in these fascinating pages, we may point to the pictures of the great northern diver's floating nests with the surrounding scenery, grebes swimming about near their nests, a Franklin's gull eating the eggs of the eared grebe in the nest, the owner watching, shearwaters at sea fighting over cod livers thrown to them, and a petrel characteristically "walking on the water." No field ornithologist should be without this interesting book.

In "Nature Biographies" the lives of some everyday American butterflies, moths, grasshoppers, and flies are told and depicted in a delightful manner, the camera having been used most successfully in many ways; for instance, in showing the gradual develop-

ment of a butterfly emerging from the chrysalis, caterpillars feeding, the webs or tents woven and leaves curled up by caterpillars for their protection, and various insects in natural attitudes. We hardly think that "mourning-cloak butterfly" (under which name the life-history of this butterfly is ably dealt with) is any more happy than Camberwell Beauty. To read this dainty volume is to get a fair knowledge of the elements of entomology in a very pleasant way.

"The Brook Book," on lighter paper than the two volumes of this series just noticed, consists of a number of chapters describing the plants and live creatures to be met with in rambles along the banks (and in the bed) of brooks. Some of them relate the doings of a college walking party which explored their neighbourhood, and the occasional introduction of a professor or a "visiting geologist" leads to informing chapters, while the adventures of the members themselves add a vein of humour. It is impossible even to state the wide range of subjects so pleasantly dealt with, but they cover the settings and occupants of various kinds of brooks; and the enthusiasm of the writer and her pleasant way of introducing the subjects make the book just the thing to read aloud to elder children, and to instruct oneself with at the same time. The sixteen half-tone plates of brook scenery are very beautiful, and there are nearly seventy line engravings in the text.

We have in a volume of the American Sportsman's Library a capital guide to the waterfowl of North America, at once readable and scientific, and useful alike to the naturalist and the sportsman. Introductory chapters treating of the structure, character of the plumage, migrations, and the use as food and ornament of these groups, and of the necessity of affording them protection in spring, are followed by descriptions of the chief stations for wildfowling and of the various modes of shooting ducks and shore-birds. These chapters are written in the graphic language of an enthusiastic and thorough "workman." The details of actual shooting days and nights, with exciting and amusing incidents, written with a certain amount of expressive "western" words, will appeal strongly to all who have felt the glamour which hangs about "wildfowl." The body of the book is taken up with a scientific description of each species, giving details of the different stages of plumage at all ages and seasons, measurements, eggs, and habitat, followed by a general account of the habits. The waterfowl of the Pacific coast are separately dealt with, and the book closes with diagnoses of the families and genera. It is beautifully, though not profusely, illustrated, and the letterpress is printed on nice light paper, which makes this pleasing volume not too heavy to be held comfortably, despite its six hundred pages.

The object of Mr. Lange's handy volume is to point out to teachers some of the material which may be made the basis of profitable lessons in nature-study, and he has endeavoured to show how this material may be made available, and what the pupils may be taught about it. The plan here advocated is to take the children out into the fields and woods and to show them, and let them examine, various natural objects, or to bring before them prepared and preserved objects and to instruct them in these. The teacher is told how best to do this. The book, indeed, consists of a series of lessons on various natural objects, in which the requisite information is given, and the teacher is told what material is necessary and how to obtain and use it. The author has been successful in producing a valuable manual of work for children whose school years close with the common school course. The numerous woodcuts are useful and to the purpose. Unfortunately for English readers the country for which the book is especially designed is the eastern States of North America. O. V. APLIN.

THE NATURE OF ELECTRICITY AND THE CONSTITUTION OF MATTER.

Conduction of Electricity through Gases. By J. J. Thomson, D.Sc., LL.D., Ph.D., F.R.S. Pp. vi + 566. (Cambridge: University Press, 1903.) Price 16*s*.

THIS book on the newest branch of physics, from the pen of its originator and chief exponent, deals with one of the most rapid and remarkable developments of modern scientific research. The "ionisation theory of gaseous conduction," it is claimed in the preface, not only gives a simple and direct explanation of the electrical properties of gases, but also affords the means of subjecting the fundamental problems of the nature of electricity and the constitution of matter to direct experimental attack. The reason is very clearly set forth.

"The possession of a charge by the ions increases so much the ease with which they can be traced and their properties studied that as the reader will see we know far more about the ion than about the uncharged molecule."

There is food for reflection for both the man of science and the philosopher in this comprehensive remark. Less than a decade ago the possibility of the existence of a gaseous ion was hardly recognised. To-day this volume of very respectable dimensions testifies to the wealth of researches that have followed the inception of Prof. Thomson's theory. The researches of the author and his former pupils, Rutherford, Townsend, C. T. R. Wilson, Zeleny, Strutt, H. A. Wilson, Langevin and many others are brought together in this book and correlated with older researches and with those that have been proceeding simultaneously elsewhere.

In the two opening chapters the fundamental position is developed that the charge carried by the gaseous ion is the same for the ions of all gases, is independent of the ionising agency, and is equal to that carried by the hydrogen ion in electrolysis. This conclusion is arrived at from considerations of the diffusion velocity of the ions, and their velocity in an electric field, and needs only the assumption that the ions behave like the particles of a perfect gas towards pressure.

A second and completely independent determination of e for the same kind of ions is made possible by the application of the condensation experiments of C. T. R.

Wilson to the direct determination of the absolute number of ions present, and therefore of the individual charge carried by each ion. These are discussed in chapter vi., and lead to the same conclusion, that the charge is equal to that of the hydrogen ion in electrolysis. In chapter v. the ratio e/m of the charge to the mass is determined for the rapidly moving charged particles shot out by radium, by metals *in vacuo* under the influence of ultra-violet light, and by the kathode in the form of the kathode ray in the electric discharge through highly rarefied gases. A combination of the values of e found in chapters ii. and vii. with the ratio e/m found in chapter v. leads to the conclusion that m must be of the order of one-thousandth of the mass of the hydrogen atom.

On this is based the author's "corpuscular theory of electricity." The corpuscles—and it is to be noticed that the term *electron* is not used—are the discrete particles of negative electricity the presence or absence of which determines negative and positive electrification, and since the value e/m for the positive ion is never greater than for the hydrogen ion, it is concluded that a positive corpuscle does not exist, and the positive ion consists of the whole atom less one corpuscle.

The reader at this stage of the reasoning will probably question the propriety of thus combining the values found for e and e/m, for the two quantities have been determined for ions of completely different character. An earlier and more consecutive discussion of the dual character of the ion, according as to whether its charge or its energy is its chief experimental characteristic, and the adoption of some distinction in the nomenclature between the ions of the two classes, would no doubt have made the subject more clear. But it must be admitted also that this distinction, and the assumed identity of the charge for the two classes, is a point of weakness in the otherwise strictly consecutive train of reasoning. The critical stage of transition, where the ions of the first class change into the ions of the second—the slow diffusing negative ion in gases at high pressure, for example, acquiring under the action of an electric field, as the pressure of the gas is reduced, the energy and velocity of the kathode ray—seems to need further experimental study; for the conclusion that it is brought about by the ion shedding its attendant cluster of molecules and then travelling free seems mainly a consequence of regarding e as invariable. Although, no doubt, the arguments in favour of doing so are very strong, yet they appear somewhat indirect, and the anomaly that the slower moving ion is less effective as a nucleus for the condensation of moisture (p. 153) shows that the arguments are not all in its favour.

The view expressed in the chapter on ionisation by incandescent solids that the corpuscles exist in free motion inside metals and carbon, from which they escape when their kinetic energy is increased by rise of temperature, is, as the author points out, of great importance in its bearing on the variation of chemical affinity with temperature. Indeed, this book will be read by chemists with interest for the light it throws on the possible causes underlying phenomena often considered simple merely on account of their familiarity.

The chapter on Becquerel rays is the longest in the book, and comprises a brief review of the most important work in radio-activity up to the commencement of the present year. Special prominence is given to the work of Rutherford, whose application of the ionisation theory to the problems of radio-activity has been so fruitful of discoveries. The applications of the theory to the spark discharge, the electric arc and the phenomena of the vacuum tube are treated very fully, and the last chapter includes a discussion of the important results of Kaufmann on the variation of e/m with v for the rapidly moving negatively charged particle from radium. The view is expressed that these results accord with the possibility that the whole of the mass of the corpuscle is electrical in origin.

The treatment, although exhaustive, is confined strictly to the subject-matter of the title, and the recent advances in spectroscopy of the inner constitution of the atom find no place. It is interesting to notice that Prof. Thomson frankly abandons all attempt to distinguish in nomenclature between the two forms of "radiation," the undulatory and the corpuscular, with which modern physics now has to deal. Both are designated "rays," and this extension of meaning, which is practically inevitable, is, of course, in strict accordance with the original Newtonian sense of the word.

F. S.

AN ENGLISH EDITION OF "ASTRONOMY FOR EVERYBODY."

Astronomy for Everybody. A Popular Exposition of the Wonders of the Heavens. By Prof. Simon Newcomb, LL.D., with an introduction by Sir Robert S. Ball, LL.D., F.R.S. Pp. xv+341. (London: Isbister and Co., Ltd., 1903.) Price 7*s.* 6*d.*

WHEN a popular exposition of the wonders of the heavens is written by such a man as the distinguished author of this volume, the reader, and more especially he who is greatly inclined to this science, naturally expects to find not only new ideas in the art of expressing difficult issues in simple language, but judgments on various doubtful points by one who is in the foremost rank of his work. The book before us is intended, as the title indicates, for the general reader, and should therefore be not only clear, concise, and accurate, but should be illustrated with the best diagrams and pictures of the period. The reader will therefore be very disappointed to know that this standard of excellence is by no means reached in these pages.

The general scope of the book is as follows:—First, the general ideas of the motions of the celestial bodies are dealt with, the reader being also briefly introduced to the chief kinds of instruments employed in investigating the motions and physical conditions of these bodies. The sun, moon, earth, planets and their satellites are next each described, then comets and meteors come in for their turn, while a general review of the fixed stars fills up the remaining portion of the book.

The work thus covers the domain of general astronomy, with, however, one notable exception, namely, the omission of all reference to new stars! The reader is thus left entirely ignorant not only of the facts that such bodies as Nova Aurigæ, Nova Persei, Nova Geminorum, &c., ever existed, but of the various hypotheses put forward to explain the sequence of the interesting and important phenomena which are so characteristic of them.

This omission is, however, not the only blot which mars this book, for unfortunately errors of another kind are by no means uncommon.

Those who have taught astronomy know how important it is to give the student a correct idea of the difference between "rotation" and "revolution," so that the beginner may clearly grasp the facts that the former is responsible for our day and the latter for our year.

For a popular work, such as this, the definition of rotation could scarcely be more clearly explained than is done under the heading "rotation" in Webster's Dictionary (1902):—"The act of rotating or turning, as a wheel or a solid body on its axis, as distinguished from the progressive motion of a body round another body or a distant point. Thus, the daily turning of the earth on its axis is a rotation; its annual motion round the sun is a revolution."

With these definitions before us the following extracts from the book under review may be of interest. On p. 11, for instance, the reader is told that "the earth is not at rest, but *revolves* unceasingly around an axis . . .," and on the same page that "this real *revolution* of the earth, with the apparent revolution of the stars which it causes, is called the *diurnal motion*. . . ." Again, on p. 19 we read, "as the earth *revolves* on its axis. . . ."

If the author had expressly stated that his definition of "rotation" referred to *points* on the earth's *surface* and not to the earth as a whole, then the above statements might be valid, but as he makes no mention of this, the beginner will undoubtedly become perplexed as regards these motions.

A little further on (p. 35) a description is given of how the obliquity of the ecliptic produces the changes of seasons. Unfortunately (line 9) the word "orbit" is printed instead of "axis," an error which by no means renders the explanation very clear.

Another difficulty which the beginner will have to overcome occurs on p. 57, where the illustration showing the axes on which a telescope turns is placed on its side. Apropos of the incorrectness of diagrams, an error occurs in the drawing of the path of the rays (p. 68) illustrating the principle of the Newtonian reflecting telescope. Here the "flat" or "secondary mirror" is placed outside the focus of the large reflector, so that the rays which after reflection from the latter fall on it are divergent and not convergent.

In this chapter it is stated that "the largest mirrors so far successfully made and used have been about four feet in diameter." The author does not seem to be aware that the late Dr. Common constructed, mounted, and used a mirror measuring five feet in diameter.

It might also be suggested here that the diagram of the solar spectrum (p. 75) should be placed horizontally and not vertically, as this latter position would tend rather to confuse than to enlighten beginners when they are confronted later with terrestrial or celestial spectra.

On p. 114 a rather perplexing statement is made:—

"if we imagine ourselves standing *exactly* on a pole of the earth, with a flagstaff fastened in the ground, we should be carried round the flagstaff by the earth's rotation. . . ."

To the writer of this notice it seems that the flagstaff would travel round the observer if the observer be standing *exactly* on a pole of the earth as is stated; of course, it is meant that the flagstaff should be placed on a pole and the observer near it, but the reader has good cause to be puzzled.

A point which calls for special attention when giving our readers an idea of the contents of this book is the extreme poorness of the illustrations. One would have thought that advantage would be taken of the wealth and excellence of astronomical photographs that are now available, and the facility and accuracy with which they can be reproduced; but this is not the case.

Sun-spots are represented by a single drawing made many years ago; comets are illustrated by four drawings made by G. P. Bond, instead of by some of the beautiful photographs secured at recent appearances. Further, Bond's drawing of Donati's comet is so badly reproduced that probably the original artist would not be able to recognise it; the frontispiece, an impression of the solar corona of 1900, is decidedly feeble. The reader is not shown either a stellar spectrum or a reproduction of Hale's fine spectroheliograph photographs, or even a spectroscope or objective prism telescope.

From the above remarks it will be gathered that the book before us is not the best that could be placed in the hands of a beginner, and it seems a pity that more trouble was not taken in its production.

HISTORY OF ELEMENTARY MATHEMATICS.

Geschichte der Elementar-mathematik in systematischer Darstellung. By Dr. Johannes Tropfke. Erster Band. Pp. viii+332. (Leipzig: Veit and Co., 1902.) Price 8 marks.

THE great work of Moritz Cantor has made him, as it were, the Gibbon of mathematical history. But the extent of his subject has prevented him, as a rule, from entering into detail, and there are many things of great interest about which it is not easy to get information without laborious research. The history of mathematics is being studied, and its value is recognised, not only by those who make it their special domain, but by an increasing number of practical teachers, so that there is both a demand for books dealing with various parts of the subject in different degrees of detail and a school of historians ready to supply them.

Dr. Tropfke's work is not exactly a popular treatise. He has limited himself to the range of elementary

mathematics, and in this volume deals only with arithmetic and algebra; but his treatment is thorough, and his aim has been to give exact references to the original authorities for the statements in the text. The amount of labour that this has involved must have been very great; when the work is complete, with the indexes promised by the author, it will be a valuable repertory for those who wish to learn the facts at first hand. The number of bibliographical footnotes exceeds 1200, and since many of these give more than one reference, it will be seen how great a service the author has rendered to those who are inclined for research.

But the book is far from being a mere dry collection of facts and references. The style is concise, and there is no catchpenny rhetoric, but there is plenty to interest any intelligent reader. The arrangement allows us to trace in detail the development of methods and of notation; we are shown, with explanations, the actual symbols used and the processes employed by our predecessors; most important of all, there is an appendix with a selection of original examples ranging from Alchwarizmi to Leibniz and Newton. Few things are more instructive than an inspection of some of the older methods in arithmetic. Until the end of the fifteenth century, long after the decimal notation and the use of the "Arabic" numerals had become familiar, and when arithmetical calculations were usually worked on paper, the rule for performing long division was of a most complicated character, with rows of figures above the dividend as well as below, and tedious cancellings and substitutions which must have made the operation both laborious and liable to error. It is almost certain that the process is of Indian origin, and it is probable that the figures which, in written examples, we find cancelled by a stroke drawn through them represent digits which were actually obliterated at an earlier period, when the calculation was performed with a stick on a layer of sand.

A striking feature of early European books on arithmetic is the bewildering number of their so-called "rules." One reason for this is simple enough. Many of these books were intended to help business men—bankers, merchants, and so on—in such calculations as their calling obliged them to do. Their interest in arithmetic was purely practical, and all they wanted was a bundle of recipes for getting correct answers to questions of certain special types. Even in our own day we occasionally see such terms as "agricultural book-keeping" or "chemical arithmetic," which show that a demand for this sort of thing is not yet extinct. But even in treatises of a more theoretical kind *duplatio* and *mediatio*, in other words doubling and halving, were reckoned as separate rules. This is a historical survival, a sort of fossil relic of prehistoric times. It appears that the ancient Egyptians performed multiplication by a process practically equivalent to converting the multiplier into the binary scale; thus

$$x \times 13 = x \times 8 + x \times 4 + x,$$

where $x \times 8$ and $x \times 4$ were obtained by successive doubling. When an improved method of multiplication had been discovered, the older process became obsolete; but *duplatio* held its ground as a special rule, in recognition, so to speak, of its former importance.

A considerable portion of this volume is naturally devoted to the theory of surds, and this cannot be separated from the Greek theory of geometrical irrationals. After all that has been written on the subject, *lacunae* remain which will probably never be filled up, unless new documents are discovered. Some undoubted facts are very puzzling when taken in combination. For instance, Euclid says in so many words that incommensurable quantities are not related to each other as numbers, and it really does seem that to a Greek geometer of Euclid's time the relation, as to length, of the diagonal of a square to one side was something different *in kind* from the relation of two commensurable distances. At the same time the Greeks must have been practically acquainted with what we should call rational approximations to $\sqrt{2}$, and it is well known that the irrationalities considered in the tenth book of Euclid's "Elements," when put into an algebraic form, correspond exactly to all the members of a particular group of surds, without omission or redundancy. Did the geometers, who professed to despise "logistic" in public, privately make use of it to help them in their researches?

Other subjects considered under the head of algebra are the development of the idea of number in general, the operations of algebra and their symbols, proportion, and equations. Under the last heading Diophantine analysis is included, and it may be noted as a fact not generally known that Diophantine equations of the form

$$px^2 - qy^2 = r$$

were actually discussed in India at least as early as the time of Brahmagupta—that is to say, more than a thousand years before Fermat proposed the Pellian equation to the English mathematicians. G. B. M.

OUR BOOK SHELF.

La Lutte pour l'Existence et l'Évolution des Sociétés. By J. L. de Lanessan. Pp. 277. (Paris: Félix Alcan, 1903.) Price 6 francs.

The title of this book is most misleading. The reader naturally expects to find an account of the struggle for existence among primitive men and of the evolution which has resulted from the struggle. The first chapter has quotations from Buffon and Darwin which leave no doubt in one's mind that this is the line which is to be followed. After this comes a description of primitive society or rather the social system which the author assumes to be primitive. The struggle for existence drops out, and is not mentioned. Society begins, he tells us, with a severely patriarchal *régime*. He seems not to have heard of an earlier polyandrous period. Out of the family bond arose the sense of duty. Speaking of the tribe, he lays it down that the chieftain was regarded as the owner of all the land which the tribe possessed.

After this glance at primitive society, we plunge into French history. Many great questions are dealt with, and most of them with remarkable shrewdness. Our author discusses the origin of feudalism. He next decides that Christianity had nothing to do with the abolition of slavery. He traces the growth of the idea of liberty among the peasantry; it showed itself

in the *jacquerie* of the fifteenth century, which was the precursor of the revolution. He has much to say about the power of the clergy, about the national attitude of the Gallican Church followed by its eventual submission to the Pope.

With the revolution we begin to get a glimpse of what was in the author's mind when he gave his book its title. Only for a short time do the plebeians obtain liberty. Power is soon grasped once more by the well-to-do classes. What the revolution gained for the working man was the right to work when and at what work he chose. It introduced, in fact, free competition among individuals. As an individual the workman was free, but associations of workmen had as yet no legal status. Indeed, in 1791 the national assembly forbade combinations, whether among workmen or employers, intended to influence wages or prices. It is against this free competition between individuals that M. de Lanessan preaches. So far from bringing the best and strongest to the top, this Darwinian struggle for existence, as he terms it, causes nothing but misery. But has he any understanding of Darwinism? Darwin recognised not only a struggle between individuals, but a struggle between groups. If France is to hold her own against rivals, there must, no doubt, be mutual help among her citizens. There is nothing un-Darwinian in this. At the opening of the last part of the book, our author gives his views upon heredity, and it turns out that he is so Lamarckian that the struggle for existence seems to find no place in his theory of evolution; it is only a pest to be put an end to. After this, he passes on to the subject of the amount of food required by a workman, thence to alcoholism, which he attributes mainly to want of proper food, thence to the injurious effect of many of the substances employed in manufactures, thence to factory legislation. With all the main evils from which the workman suffers, the Third Republic has made an honest attempt to grapple. Before 1870 the policy of *laissez faire* was in the ascendant. There is much of interest in the book, and the style is clear, but "The Duties of the State" would have been a better title.

F. W. H.

Ore Deposits. A Discussion. Pp. 90. (New York: *Engineering and Mining Journal,* 1903.) Price 5*s.* net.

GEOLOGISTS and miners will be grateful to Mr. T. A. Rickard, the editor of the *Engineering and Mining Journal,* for having reprinted the report of a discussion upon ore deposits which took place before the Geological Society of Washington in the early part of the present year. Many leading American geologists, whose names are identified with the study of mineral deposits, were present, and took part in the discussion, so that the mining engineer now has before him, in the form of a small handy volume, a clear and authoritative statement of the views of men well qualified to express opinions upon a very difficult subject.

Geologists are accustomed to frame hypotheses upon the origin of rocks, and naturally they are dissatisfied with a classification of ore deposits dependent upon form, and favour genesis as a basis of arrangement. In this spirit Mr. W. H. Weed put forward his tentative classification of ore deposits, which occupies two and a half pages of the book. He wisely admits that ore deposits may have originated in very many ways, and says that his six classes "have been arranged to show gradation from the magmatic segregation of original igneous rocks to the deposits directly or indirectly due to the emanations from igneous rocks up to those due entirely to aqueous agencies."

Mr. J. E. Spurr followed with another classification, and Mr. C. R. Van Hise with a third. "Who shall decide when doctors disagree?" Until geologists are in harmony among themselves, the humble miner will probably do well to wait, much as he would like to have a purely genetic classification, and rest content in the meantime with his old subdivisions according to form. Besides, the miner wants something broader than a mere classification of ore deposits; he has to deal not only with ores, but also with the so-called "non-metallic" minerals, such as abrasives, borax, diamonds, gypsum, petroleum, phosphates, &c., and he consequently desires a scheme of arrangement of all mineral deposits less narrow than will be found in a treatise upon "Erzlagerstättenlehre."

Storage Battery Engineering. By Lamar Lyndon, B.E., M.E. Pp. viii+382. (New York: McGraw Publishing Co., 1903.) Price 3 dollars.

THIS book aims chiefly at treating the engineering side of storage batteries, such as the design and installation of a battery equipment, the precautions which have to be taken to maintain such an equipment in good working order, and the various accessory devices which have to be used therewith. The chemical side of the subject is treated very briefly; the first chapter, of less than a dozen pages, is all that is allotted to general theory. In the remaining chapters of the first part the characteristics of lead cells are considered in detail; the leading types of cell are described, and there is the usual series of illustrations of different grids. Considering that the book makes no pretence of being a complete treatise on accumulators, we think that much of the matter here included might with advantage have been omitted, and the material sifted with more discrimination. There are also several instances of carelessness; for example, the author speaks of forming Planté plates in a solution of litharge in *potassium,* a mistake repeated three or four times in a couple of pages. The treatment of the electrical and mechanical sides is less open to objection, and many useful suggestions are given as the results of actual experience.

The second part of the book is devoted to auxiliary apparatus; it is concerned with the use of accumulators in connection with distribution systems. The author describes at length the use of end cells or counter E.M.F. cells for voltage regulation, and the most suitable types of switches, hand regulated and automatic, to employ with them. The use of boosters and methods of wiring are considered at considerable length. On the whole the book should prove of value to the practical engineer, as it deals with an aspect of the storage battery which has not hitherto, so far as we are aware, received much systematic consideration.

M. S.

Cassell's Popular Science. Edited by Alexander S. Galt. Pp. viii+576. (London: Cassell and Co., Ltd., 1903.) Price 12*s.*

THIS handsome volume is a worthy attempt to popularise the physical, chemical, biological, and geological sciences. As the editor remarks, popular science has too often been synonymous with inexact science, and any attempt to show that scientific knowledge may be presented in an interesting manner, and be at the same time correct, is to be welcomed. The book is profusely illustrated and contains a well-selected series of brightly written essays on various subjects of pure and applied science. The volume may be recommended as a suitable present to boys and girls, who will probably by its means be led to study more deeply one of the many branches of science of which some of the methods and results are described.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Engineering Equipment of the Manchester School of Technology.

THE report on engineering work at the British Association Meeting at Southport in your issue of October 29 contains certain criticisms with regard to the engineering equipment of the Manchester School of Technology. The responsibility for the character of this equipment rests ultimately upon me as the professional adviser of the Technical Instruction Committee, and I would therefore seek some space in your valued columns for making reply.

The criticism takes two forms:—(1) that the laboratory equipment is unnecessarily complicated and beyond the capacity of the class of students the school is likely to obtain; and (2) that in any case, even if justifiable as to its nature, it was wrong to put in so much plant at once, but that part of it should have been held back until the growth of students showed a necessity for it.

The reply to both is, that it was in the hope of attracting that very class of student the critic is so sure we are unlikely to secure that so extensive and elaborate a plant was installed.

The great defect of technical education as hitherto conducted in this country has been its restriction to the teaching of elementary engineering science and to a few stock laboratory operations, such as breaking specimens in a testing machine, taking indicator diagrams from steam and gas engines, and making the simpler hydraulic experiments. This restriction was necessary, because the pupil, being a youth fresh from school, who had never seen the inside of an engineering workshop, and had to be taught everything from the commencement, could not be expected to advance very far in engineering knowledge. When he afterwards went into practical work, the knowledge acquired at the technical school being of no immediate use to him, he was no better off than if he had gone straight from school to the works, and his employer was not slow to notice this and draw the inference that the work of the technical school was practically of no value to the engineering industry. This is why the large majority of employers take so little interest in "technical education."

In Manchester, on the other hand, we have broken fresh ground, and are attempting to convince the engineering leaders that if they provide us with only one or two of the best young men out of each of their works, who have spent a few years in the workshop, and who know the elementary parts of geometry, algebra, trigonometry, and mechanics, we can, with two years of study and experimental work, turn out a product superior in every useful respect to even the much vaunted Charlottenburg *diplomé*, and of real and immediate monetary value to the profession.

We propose to prove this by showing those leaders the practical utility and industrial value of the results of our research work, and also by returning to them their young men, not mere beginners without self-confidence (though stuffed with formulæ), but trustworthy observers, resourceful experimenters, and men of imagination, who are able to impart new ideas to those engaging them, and to help them to work these ideas out in a practical way.

Take, as an example, the experimental engine to which you refer as being a huge mistake.

Take it for granted that a large percentage of the waste in steam engines is due to the defective design of valves. If we can show to some of these young designers of the future by experimental research upon this engine how these valves are defective, and in what direction to look for improvement, we are surely aiming at a higher measure of utility than could be attained by demonstrations with any number of varieties of the market article, however modern.

In regard to the remarks made about the equipment becoming obsolete, the scope and object of the plant has again been entirely misunderstood. The laboratories are not intended to serve as museums of modern appliances which the student comes to examine, copy, and store his memory with, but as a collection of machines typical of the various branches of mechanical engineering, specially fitted up for the purpose of studying the action of those working fluids and those moving mechanical elements which are common to all forms of prime movers and energy absorbers, past, present, and to come.

With reference to the question of the size of the individual parts of the equipment, one of the things for which, in my opinion, local engineers must ever feel grateful to the Manchester Technical Instruction Committee is the courage they showed in putting down plant on a true engineering scale. No practical experimental results worthy of attention could otherwise have been obtained. It could hardly be expected, for example, that an engineer, wishing to know the laws of the action of automatic drop valves for a design of large high-speed pump, should rest content to be guided by experiments made with a donkey-pump, however elaborate they might be.

In concluding, may I give expression to my belief that the promise for the future of British engineering lies in practical experimental research, strenuously carried on either in the workshop- or the college-laboratory by men specially trained for the purpose, and that the sooner we get rid of the notion that teaching schoolboys some engineering theory and the making of a few stock laboratory experiments constitutes the proper education for the engineer of to-day, the sooner we shall begin to recover from the reproach of having fallen behind the foreigner.

JOHN T. NICOLSON.

On two Constants A_1 and A_2 in the Kinetic Theory of Gases.

MAXWELL has introduced two constants A_1 and A_2 in the kinetic theory of gases (*Scientific Papers*, vol. ii. p. 41), defined by the integrals

$$A_1 = 4\sqrt{2}\ \pi\int_0^{\frac{\pi}{4}}\frac{\sin^2\theta}{\sin^2 2\phi}d\phi,$$

$$A_2 = \sqrt{2}\ \pi\int_0^{\frac{\pi}{4}}\frac{\sin^2 2\theta}{\sin^2 2\phi}d\phi,$$

where

$$\theta = \frac{\pi}{2} - \sqrt{\cos 2\phi}\ K(\sin\phi),$$

K being the complete elliptic integral of the first kind with modulus $\sin\phi$. These constants enter into the discussion of various properties of gases, on the assumption that the gas molecules repel each other according to the inverse fifth power of the distance. The values of these integrals, as found by mechanical quadrature, are

$$A_1 = 2{\cdot}6595 \qquad A_2 = 1{\cdot}3682.$$

Constructing a graph of $\sin^2\theta/\sin^2 2\phi$, I chanced to notice that the convexity is turned towards the axis of ϕ, so that the quadrature used by Maxwell must make A_1 a little too large. With the second integral, the number of points near the maximum of $\sin^2 2\theta/\sin^2 2\phi$ is insufficient, so that the value of A_2 will turn out to be too small.

Of the different methods of evaluating these two integrals, that of Gauss ("Methodus nova integralium valores per approximationem inveniendi," Werke iii. pp. 163–196) evidently leads to more accurate results than taking a number of equidistant points. This method of quadrature can be applied in two ways. The integrands $\sin^2\theta/\sin^2 2\phi$ and $\sin^2 2\theta/\sin^2 2\phi$ can be expanded either in power series of ϕ or of $q=e^{-\pi\frac{K'}{K}}$, where K and K′ are complete elliptic integrals of the first kind. Since

$$d\phi = 2/\sqrt{q}(1-4q+6q^2-8q^3+13q^4-12q^5+\ .\ .\ .)dq,$$

we can effect the approximate integration by finding either the values of ϕ or of $\sqrt{q}$ between the limits of integration, proportional to the roots of zonal harmonies of nth order $P_n(\mu)$, and proceeding according to the method indicated by Gauss.

These tedious calculations were undertaken by Messrs.

K. Aichi and T. Tanukadate, post-graduate students in physics, with the following results:—

Considered as Power Series of ϕ:

For $n=6$: $A_1=2\cdot6512$ $A_2=1\cdot3704$ (Tanukadate)
For $n=7$: $A_1=2\cdot6512$ $A_2=1\cdot3704$ (Aichi)

Considered as Power Series of $\sqrt{q}$:

For $n=4$: $A_1=2\cdot6509$ $A_2=1\cdot3750$ (A. and T.)
For $n=7$: $A_1=2\cdot6511$ $A_2=1\cdot3704$ (A. and T.)

It thus appears that the number of points for $n=4$ is insufficient, but for $n=6$ or 7 the approximation becomes very close, so that the values of these two integrals are:—

$$A_1=2\cdot6512 \qquad A_2=1\cdot3704.$$

Maxwell's value of A_1 is about 1/300 too large, and that of A_2 is about 1/600 too small. Such small differences will not materially affect the theoretical results in which these two integrals enter, but it will be worth while to notice that the actual values are slightly different from those usually given in works on the kinetic theory of gases.

H. NAGAOKA.

Physical Laboratory, Imperial University, Tōkyō, October 8.

Leonid Meteor Shower, 1903

THE return of the Leonids was clearly observed here on the night of November 15. The night of November 14 was also clear, though at times a dark belt of cloud, which concealed the lower part of Orion, extended itself along the eastern horizon to the foot of Leo, and occasionally also small patches of cloud dimmed or caused a momentary disappearance of stars in or around Gemini. These slight impediments to observation continued also on the next night until between two and three o'clock on the following morning. It had been intended to commence observations here as early as the night of November 11, as the writer had anticipated that the Leonids would put in an early appearance in the present year; cloudy skies, however, prevented the possibility of knowing if these anticipations were realised. During a watch from 10h. 20m. to 12h. 30m. on November 14 (local time) eleven meteors were observed, almost half of which were Leonids as bright as stars of the first or second magnitude. The radiation from Leo was regarded as surprisingly good, considering the hazy or clouded appearance of the horizon, which rendered that constellation invisible until after midnight. In a forecast made by the writer for the present year he found that, so far as the Leonid epoch of November 14–16 was concerned, the maximum would fall between the hours 13 and 14 on November 15; but it was considered that the display on the latter night would be weak, owing partly to the reported insignificance of the Leonid shower on the night of November 15, 1902, the preparations for the due observation of which were generally frustrated by unfavourable atmospheric conditions. When, therefore, the radiation from Leo was found to be so pronounced during the early hours of the night of November 14, the writer found that he had entirely underestimated the probable strength of the shower for 1903. The watch, however, was not prolonged beyond 12h. 30m. on the night of November 14, as there was no possibility of a star shower taking place on this night, though, no doubt, there were manifest signs that the Leonids might be unusually numerous. The first watch on the following night lasted from 9h. 15m. to 10h., during which time four meteors were seen, one of them being a Leonid as bright as a first magnitude star. Its appearance was revealed by the rich streak it left in its wake as it slowly rose from the invisible radiant. The watch was resumed at eleven o'clock, and whatever misgivings might have been felt for abandoning the lookout on the previous night were quickly dissipated by the appearance of as many Leonids in the first quarter of an hour's observations as had been seen during a period about five times as long on the preceding evening. Between 11h. and 11h. 30m. the meteoric rate was twenty-two per hour for one observer facing due east, but by midnight it had fallen to sixteen per hour, though sporadic meteors were included in the count. Between 12h. and 13h. drifting patches of cloud probably prevented several meteors from being observed, and the rate did not rise above thirty per hour, but at 15h., when the sky had become quite clear, Leonids were appearing at the rate of one per minute. During the next half hour forty-one shooting stars were counted, and this high rate was more than maintained for the next two hours; indeed, it was estimated at one time that the meteoric rate was easily 200 per hour for one observer. The brilliancy of the display was as remarkable as its numerical strength. When the shower was at its maximum, few of the shooting stars seen were less bright than the second or third stellar magnitude; indeed, most of them, if observed apart, would have merited individual description, and almost every third or fourth meteor might be called a bolide. To an observer looking eastwards the radiation from Leo was very marked, but a few instances were characterised by a centripetal rather than the usual centrifugal motion as regards the well-known radiant. The most noted of these exceptional cases occurred between one and two o'clock, when a bolide of surpassing splendour passed slowly downwards, leaving a rich trail across the stars ϵ and ζ Leonis. When close to the "Sickle" it exploded with a vividly white flash that imparted to it an almost startling brilliancy, and an instant afterwards a meteor as bright as Sirius made its appearance about twenty degrees further on, shooting down towards the horizon in a path that seemed to be a production of that of its more brilliant predecessor. Another meteor brighter than Jupiter shortly afterwards moved slowly downwards from within the "Sickle," passing between γ and η Leonis one-third nearer the latter than the former star, and pursuing a course parallel to the line joining η and Regulus. This west-to-east motion of the most brilliant members of a meteor display (for it has been noticed on other occasions by the writer) appears very significant. Several shooting stars shot from ϵ Leonis to β Canis Minoris, or slightly below the latter star. There seemed to be a second centre of emanation much lower down in the "Sickle" than that indicated by the foregoing meteors, and there was certainly another radiant altogether far away from Leo, and situated probably in or near Perseus. Several bolides passed out of sight overhead, arresting the attention only by their exploding flashes that momentarily illuminated the whole heavens. The pear-shaped appearance of meteors in the morning hours was very remarkable. These left rich trains which, like the meteors themselves, appeared of a yellowish tinge in the light of the waning moon or in the increasing twilight. Other members of the star shower dissolved in bright streaks, or made their appearance as vivid flashes of light, in the latter case generally at a great distance from Leo, bursting forth at one moment near the Great Bear, and in the next in the neighbourhood of Sirius. The largest number of meteors visible at one time was four. At six o'clock the activity of the shower, though considerably diminished, was still, even in the morning twilight, very noticeable.

The somewhat prolonged duration of the meteor shower affords some measure of its intensity, and it is probable that it has been widely observed, notwithstanding the fact that the notion of the supposed connection of the Leonids with the comet of 1866 precluded the possibility of such a striking meteoric occurrence in 1903, for the present is unquestionably the brightest Leonid display that has been subjected to European, and very probably also American, observation since the brilliant star showers of 1866–8. It is noteworthy that the present shower resembles very much in intensity and also in other particulars a bright display in 1865, in which year it was estimated that one thousand Leonids might have been counted by observers in England on November 13. A lapse of thirty-eight years separates the two events, and this interval suggests the nineteen year-period which has already been noticed (NATURE, April 23) in the case of all the April meteor-displays of the past century, and has also been shown (*English Mechanic*, April 3) to connect several important Leonid star-showers extending over the same time. If this be so, it is possible that the years 1904 and 1905 may be marked by even richer meteoric occurrences than that which has taken place on the present occasion.

JOHN R. HENRY.

Dublin, November 18.

Volcanic Dust, the "New Bishop's Ring," and Atmospheric Absorption.

Dr. Rotch (vol. lxviii. p. 623) may, from experience, know whether this phenomenon is more prominent in the United States than in Europe, and better than can be ascertained by simply collating reports of the sky appearances as seen by different observers in the two continents, but he is mistaken in supposing that the phenomena in question have not been mentioned in European journals, as he will find a full description of the "New Bishop's Ring" in your pages (the issue of December 25 last, p. 174), particularly as observed at Sunderland.

As stated there, there was at first a striking difference from the Krakatoa "Bishop's Ring" in dimensions, but while very variable in size, it was afterwards in general reduced to more nearly the size of the Krakatoa circle.

Since the Krakatoa phenomena this circle has rarely been wholly absent about sunrise and sunset, though for some years was faint, so far as my experience goes, until July, 1902. Whether it existed at all before the autumn of 1883 I cannot say, as one's attention was not directed to it until it became conspicuous. On its recrudescence last year it did not become visible at other times than sunrise or sunset, so far as I noticed, until August 1, and it was not until some months later that it became conspicuous in the full day-time. I can reply to the inquiry of M. Forel in your issue of August 27, p. 396, that the circle is now plainly visible, not intermittently, but always, and not only about sunrise and sunset, but in the day-time; and not only at high altitudes, but at the sea-level also. But my experience so far agrees with M. Forel's that I found in a visit to Switzerland last July and August that the higher one ascended the more conspicuous the circle became—up to a certain point at least; I did not ascend higher than 8100 feet.

In answer to Prof. Langley (p. 5) I may say that I have not noticed a single night this year or last winter when the atmosphere appeared to be normally clear, stars at a low altitude having never been clearly seen here. I had also an impression as to the want of clearness during my visit to Switzerland, but I have not yet made calculations on the observations I made for absorption. During the day-time this want of clearness has not been at all observable, the sky outside of "Bishop's Ring" having been very frequently of a beautiful blue. I note that Prof. Langley makes the abnormal absorption increase towards the violet end of the spectrum. This seems at first sight rather contrary to the circumstance that I have occasionally noticed an unusual paleness of the sun when a few degrees off the horizon; indeed, it has sometimes appeared of a slightly greenish yellow, but possibly the relative clearness shown by Prof. Langley's table at μ 0·60 may have some connection with this.

I am surprised that Prof. Langley does not attribute this condition of the atmosphere to the volcanic dust. This would seem to me much the most probable explanation.

T. W. Backhouse.

West Hendon House, Sunderland, November 23.

Action of Radium on Bacteria.

Continuing the experiments of one of us on the action of radium bromide on plants, we have experimented on various bacteria. We find that, in the case of *Bacillus pyocyaneus*, *B. typhosus*, *B. prodigiosus*, and *B. anthracis* in agar culture medium the β radiations from radium bromide exercise a marked inhibitory action on growth. Exposure for four days at a distance of 4·5 mm. to 5 mgr. of radium bromide does not appear sufficient to kill the bacteria, but is adequate to arrest their growth and to maintain a patch on an agar plate, inoculated with any of these organisms, sterile. A broth tube, however, inoculated from this patch has in most cases developed the organisms, showing that while the growth is inhibited in the patch all the organisms there are not killed.

Henry H. Dixon.
J. T. Wigham.

Trinity College, Dublin, November 19.

MEDICAL SCIENCE AND THE ANTI-VIVISECTIONISTS.

THE vindication of law and common sense exhibited by the substantial damages awarded to Dr. Bayliss after a trial occupying the Lord Chief Justice and a special jury for four days must afford the greatest satisfaction to everyone who is aware of the long course of systematic persecution which has pursued all those who devote themselves to the scientific side of medicine, and culminated in an attack by Mr. Coleridge on Dr. Bayliss and Prof. Starling, and on University College where they work.

There are many points of interest in this particular battle between a heavily subsidised society and its victim, to some few of which we may briefly refer —but of greater interest in reality are those aspects of this case which illustrate the immemorial conflict between knowledge and ignorance.

It is amazing that in the twentieth century, when it is at length recognised, even in this country, still lagging far behind its Continental rivals, that throughout the whole field of education practical instruction is of paramount importance, we should see one scientific witness after another pressed to explain why it should be necessary for a proper comprehension of the functions of living bodies to see the parts of those bodies in motion. The most intricate machine in the world is simplicity itself compared to any living body, but who could be trusted to repair a watch, a motor car, or a marine engine who had never seen their mechanism in action? Who would trust his life to a pilot who had never been to sea, to a physician who had never studied by the bedside, or to a surgeon who had never witnessed an operation? Would anyone try to teach a child the scent of a violet out of a book? Yet in this case, so happily and justly decided against Mr. Coleridge and his Society, an eminent counsel has asked again and again why students need concern themselves with any more practical physiology (the foundation of all the knowledge they can acquire) than they can learn from the pages of a book, while to support such a plea pseudo-scientific witnesses living and dead were quoted as deliberately asserting that practical instruction is wholly superfluous.

No single error has done more to hinder the progress of medicine in the past than the common attempt to deduce function from structure without direct experimental verification. Yet in the face of the clearest lessons this fallacious method is continually urged upon us as if its utility was self-evident; of this illustrations could be cited almost without limit. The error of Erasistratus that the arteries did not contain blood, apparently supported by anatomical observation, blocked the road to knowledge for 500 years, and was only dispelled at last by Galen's simple experiment of tying an artery in two places in a living animal and opening the vessel between the ligatures. A late obstetric surgeon, whose mischievous prejudices were received with such faith and quoted with such reverence by the anti-vivisectionists, so little understood the information and arguments of the early anatomists that he imagined they had never seen blood flow from an artery, and would have been convinced of their error if they had done so. Another of his "professional convictions" was that the circulation of the blood could easily have been discovered by anyone with a syringe and a dead body, though he must have known that the syringe and the dead body had been in the hands of anatomists from the time of the Pharaohs at least, and that Malpighi, who discovered the capillary circulation by direct observation of the living frog, had previously been entirely misled by attempts to inject the blood vessels in dead animals. Harvey discovered the circulation of the blood by con-

tinual observation of the motions of the heart and blood vessels in living animals, and this epoch-making discovery is always wrongly attributed by anti-vivisectionists to the observation of the valves of the veins, though it must be clear that in that case they would have suggested to Fabricius, their observer, the real meaning of their presence and structure.

Sir Charles Bell, who has been quoted with wearisome reiteration to disparage experiments on living animals, and to exaggerate the exclusive importance of anatomical investigation, not only contradicted himself, but earned his scientific reputation by those experiments on living animals which he later condemned, and when he adhered strictly to "the just views taken from the study of anatomy" he fell into the greatest error which ever misled an eminent man. Two hundred years after Harvey had settled the question of the circulation of the blood for ever, Sir C. Bell, confusing himself with a syringe and a dead body, and unable to allow for the difference between it and a living one, came to the conclusion that the heart had little to do with the circulation of the blood, and adopted Galen's error that the principal force was the attraction of the vessels for the blood, and maintained that the law of gravity was abolished in living animals, but that Providence re-introduced it temporarily (!) for the arrest of hæmorrhage whenever an animal sustained a trifling wound.

Consistent in whole-hearted devotion to their own views, the anti-vivisectionists have misrepresented the lessons of the past and opposed every step of progress in medical knowledge in our own time. They profess to believe that every stage of progress in medicine has been effected, and always must be, by clinical work alone. Yet it is perfectly obvious that from classical times clinical investigation at Alexandria and Cordova and many other places enjoyed as great opportunities as could be desired, yet, until the opening of the renaissance of experimental method with Harvey about 1400 years later, medical knowledge had scarcely moved, for it is impossible to say that the physicians who mobbed Charles the Second to death, and who presumably represented the best talent of that time in England, and Dr. Guy Patin, Dean of the Faculty of Medicine in Paris, an eminent physician of about the same period, who maintained that all medical knowledge was summed up in senna and the lancet, had more real knowledge of physiology and the meaning of symptoms than Galen. And in modern times, when more progress in the knowledge of the causes and nature of disease has been acquired in a few years than in as many centuries formerly, every step of progress which has been obtained by physical science has been opposed by the anti-vivisectionists. Antiseptic surgery, which has brought more immediate relief from pain and death than any single discovery in the history of the human race, the whole science of bacteriology, with the light which has been thrown on tuberculosis, cholera, diphtheria, yellow fever and malaria, and the mysteries of infection and immunity, improvements in the operations of surgery, and the great names of Pasteur, Koch, and Lister, each and all have been assailed by the anti-vivisectionists with every species of abuse and disparagement.

Indeed, the denials or at best the grudging admission of the advances made in recent years in medicine and surgery would suggest that to the anti-vivisectionist they are actually unwelcome, as justifying the very researches which they attack.

It is a commonplace with Mr. Coleridge and his friends that they are actuated by the highest of all motives—love and humanity. The commonplace has been so reiterated that among the public it is taken as a matter of course, and even the Lord Chief Justice would appear to have regarded science and humanity as necessarily to be found in opposing camps. Let us see how far this claim of theirs will bear investigation.

If Mr. Coleridge and his friends were, indeed, the lovers of men and animals they declare themselves to be, no body of individuals in the kingdom would be less ready to receive or believe in stories of cruelties in others which would be incomprehensible and impossible in themselves. They would put them to the strictest tests, only accept them on the clearest proof, and rejoice unfeignedly were such proof not forthcoming.

But what really happened? A scientific man is accused of barbarities which would sicken a savage. The eye-witnesses repeatedly observe in silence tortures which a word would have ended, nay, they even withhold that word because it would have ended them, and yet Mr. Coleridge actually accepts this tale. He adopts it, he declares he has used every possible means to verify its truth, and he gives out this slander to the world, though he might easily have learned that these sufferings were inventions, and that the tortures of the defenceless creatures in whom he professed so deep an interest had never occurred at all. Is this humanity? Is this love, the love that thinketh no evil, or is it the wounded *amour propre* of one who has been worsted many times, whose statements have been refuted over and over again?

It is difficult to understand the secret of the paradoxes we are called upon to reconcile—philanthropists ascribing the basest actions to their fellow men, humanitarians diverting funds from hospitals, moralists supporting calumny by falsehood. The high motives which are claimed should exist, but until those claims rest upon some better foundation than asseverations contradicted by facts, we shall continue (and we should advise all others who are seriously considering this question to continue) to discount them altogether.

NYASALAND.[1]

MR. DUFF has written a very charming and illuminative book on Nyasaland, otherwise known as the British Central Africa Protectorate, where, since the beginning of 1898, he has resided as an official. His acquaintance with the little protectorate of 43,000 square miles was mainly limited to the Shire Province and the west coast of Lake Nyasa, but Mr. Duff is made of the same stuff as the late Prof. Henry Drummond—he is able to take in many salient points at a glance and to see things which do not strike the ordinary traveller or resident. (Whatever may be thought of Henry Drummond's later writings by scientific men, no scientific man acquainted with Africa can fail to regard his little work on Central Africa as one of the most remarkable contributions to the literature of the Dark Continent which has ever been published.)

Mr. Duff's work is illustrated by a few well chosen photographs and several of his own drawings, most of which are excellent, but one or two, perhaps, too sketchy and vague to consort with the general accuracy of the book. There are useful appendices, a sketch-map of the protectorate, and a good index.

The portions of the book which will most appeal to the readers of NATURE are those dealing with the flora, fauna, and human inhabitants, and these subjects occupy more than half of the book.

"If it be spring," writes the author, "the display of flowers will attract the attention of the most indifferent, blooms of every shape and hue being then abundant, from the great clusters of petals adorning certain papilionaceous trees down to the less conspicuous but equally beautiful ground flowers and

[1] "Nyasaland under the Foreign Office." By H. L. Duff (B.C.A.Admn.) Pp. xv + 422. (London: George Bell and Sons, 1903.) Price 12s. net.

creepers. Except, indeed, in the matter of tree-orchids, which are not very well represented, the flowers of Nyasaland are scarcely surpassed either in respect of variety or brilliancy by those of any other part of the world. It is true that, except here and there in the hills, they do not often grow so close together as to present unbroken masses of colour; and therefore the estimate which any particular person may form of them, as a whole, depends to some extent on his powers of observation. Still, short of always travelling in a machilla and always falling asleep in it, there is no possibility of overlooking them entirely. Ground-orchids flourish almost everywhere. Among lilies we have the Crinum, with its long, heavy, pure white blossoms; and a most effective little tiger-lily of bright gold and deep cardinal red; also a tree-lily (Vellozia), so wonderfully beautiful that, as Sir Harry Johnston says, 'even the botanists of Kew were touched, and called it *splendens*.' Then mauve irises spring up in countless thousands during the rains, and pink and crimson gladioli, and pale yellow marguerites, hibiscuses too, anemones, gentians, flowering beans—hundreds of plants, too, whose names are unknown to me, and many others perhaps which have escaped classification at the hands of the very few scientific botanists who have exploited the flora of the country."

The author is incorrect in some of his guesses as to the names of plants and trees. On pp. 111 and 112 the "euphorbiaceous" plant or tree to which he refers is none other than a common form of Dracæna or tree-lily, used throughout many parts of tropical Africa for hedges or enclosures.

The author has many interesting notes and original observations on the fauna. He shows that, contrary to the belief of such authorities as Sir Alfred Sharpe and Sir Harry Johnston, the roan antelope does apparently still exist in parts of the Shire Province. It has been generally supposed that this antelope confined its range within this protectorate to the regions west and north-east of Lake Nyasa, and did not intermingle, so to speak, with the area of its near ally, the sable antelope. Mr. Duff, however, shows that the roan antelope has been shot in the Shire Highlands. He alludes several times to rumours of the striped hyæna existing within the limits of the protectorate. We are, as a matter of fact, very ignorant yet as to the exact number of species or varieties of the hyæna genus existing in Africa, and the limits of the range of each species or variety. The actual range of the true striped hyæna is, of course, northern as compared to the existing southern range of the spotted hyæna. The striped hyæna is the only species of this group which at the present day is found beyond the geographical limits of Africa, its range extending through Syria, parts of Asia Minor and Arabia (? southern Persia) into Baluchistan and India. How far it penetrates into equatorial Africa is not accurately determined at the present time by indisputable evidence. It certainly reaches the Gambia River in West Africa. It is found in Abyssinia and some of the Nile countries, and in Somaliland. It has been *reported* to exist on the slopes of Kilimanjaro, and as far south as Unyamwezi, and also to be found in the eastern part of the Uganda Protectorate; but inasmuch as that curious creature the aard wolf (Proteles) very closely (in the eyes of the natives) resembles a dwarfed form of striped hyæna, and as the aard wolf is found at intervals throughout the whole eastern half of Africa from Cape Colony to Abyssinia, it is possible that some of the stories of striped hyænas existing in British Central Africa, German and British East Africa may refer only to the aard wolf. The brown

FIG. 1.—Wankonde of North Nyasa. From 'Nyasaland," by H. L. Duff.

hyæna, a distinct form, but one nearly related to the striped, also ranges, as a very scarce animal, from Natal in the south to equatorial East Africa in the north, and may possibly be found here and there within the limits of the British Central Africa Protectorate. The black and white monkey to which the author refers is obviously the Colobus, and not the Mangabey, which ape is nowhere found within the limits of British Central Africa, but is a form confined to the West African fauna, though it reaches as far as the western limits of the Uganda Protectorate.

The author gives a charming and accurate description of one of the Galago lemurs which are so common in this part of Africa. The writer of this review is convinced that the intelligence—the almost Simian intelligence—of most of the lemurs has been greatly underrated, as also their human characteristics, such as their ability (specially marked in the Galagos) of running on the hind feet and using the hands to box with. A Galago surprised and at bay puts his large fists almost into the positions of a human boxer. Of this interesting animal the author writes:—

"This lemur is a charming little thing to look at, with its soft bluish-grey fur, and large, solemn, perfectly circular eyes. It also makes a most engaging pet. I knew one which used to live half wild in the roof of a verandah at Zomba, coming and going without let or hindrance. In disposition he was on the whole very sociable, but inclined at the same time to be somewhat overburdened with a sense of his own dignity. At any rate, it was very easy to offend him; and when this happened he would retire to his coign of vantage in the roof, which nothing would then induce him to quit. At other times he would come out readily when called by his native name of "Changa." Five-o'clock tea was his favourite meal, and he rarely missed it, being accustomed about that time to refresh himself with a saucer of milk, which he drank with elaborate daintiness. His curiosity was infinite, and sometimes overcame his natural good breeding; but lapses of this kind often brought their punishment, as once, when he thrust his head unbidden into a small coffee cup and could not withdraw it. The sight of him thus unexpectedly bonneted I remember to this day. Though a certain sedateness marked his normal bearing, he possessed a truly wonderful reserve fund of activity, and could climb anything and jump anywhere when the humour took him. Moreover, he had a knack of alighting after the most prodigious leap almost as gently as a bird. I have known him to drop suddenly from a high curtain pole on to the edge of a tea tray without upsetting a single cup; but then of course he was a very small animal—smaller in fact than he looked, owing to his thick, fluffy coat."

There are interesting notes on pp. 85, 86, on the fish of Lake Nyasa, in which justice is done to the wonderful colours of the "blue perch."

On p. 124 an excellent description is given of the weird noises in the African bush at night time. The author also is wise enough to illustrate the monotony and stillness of the African landscape in day time and under normal conditions. He discourses on the singular beauties of the flora and the marvellous interest in the fauna, but brings home to his readers that every aspect in all seasons and under all conditions of Central Africa is not wonderful or beautiful or terrifying. Rather, perhaps, have many of these beauties and wonders to be sought for; they are not immediately patent to the eye of the untrained observer.

He still considers that as a game country Nyasaland may almost vie with any other part of tropical Africa where game is varied and abundant, and attributes the fact that no species in the splendid fauna is yet on the verge of extinction to the Game Laws, which have been in existence now for something like eight years, and which the Foreign Office has steadily enforced.

His chapters on the native races are admirable. He has evidently made himself well acquainted with the Chinyanja tongue, and through the medium of this widespread language has been able to get into touch with the natives of the Protectorate, thus collecting much new and valuable information regarding the manners, customs, traditions, beliefs, &c. To their amiable qualities he is fully alive, as also to their weaknesses and simple vices.

The remarks of the author regarding the labour question are well worthy of attention, but are not suited for discussion in the pages of this Journal. The same remark applies to his excellent chapter on the work of the missionaries, which is critical but appreciative.

THE CANADIAN ROCKY MOUNTAINS.[1]

THIS attractive volume is more than a record of mountain climbing. It gives the reader a very good idea of a considerable area of the Great Lone Land, its fine scenery and physical characteristics, introducing him to not a few "untrodden peaks and unfrequented valleys." Between the eastern base of the Canadian Rocky Mountains and the Pacific shore the earth's crust has been crumpled into a zone of parallel folds more than 500 miles in breadth, which have been deeply sculptured by meteoric agencies. South of the American border these mountains are distinguishable into the Rockies proper and the Sierra Nevada, parted one from another by the broad plateau of Utah, the latter chain being flanked on the west by the Coast Range. In Canada the three are practically fused together, the peaks running in successive ranges, almost like waves of the sea. Messrs. Stutfield and Collie selected as their field of work the region on both sides and immediately west of the continental watershed to the north of Hector Pass—that traversed by the Canadian Pacific Railway. This region, so far as they saw, consists entirely of sedimentary rocks—limestone, sometimes dolomitic, with shales or slates. It is, as mountaineers will see from the illustration which we reproduce, not unlike the Western Oberland, between the Blumlis Alp and the Diablerets, greatly enlarged laterally but not vertically, the higher peaks ranging commonly from about 10,500 to rather under 12,000 feet. The mountains, in fact, were less lofty than the authors had anticipated. One of their few predecessors had, indeed, reported the existence, some dozen leagues north of the railway, of two Alpine giants, Mount Brown and Mount Hooker, rising on either side of a pass, the one to an elevation of 16,000 feet, the other only 300 feet lower, and asserted that he had scaled the former. As, however, this indicated an ascent of about 9000 feet in little more than half an early summer's day, experts were sceptical; the more so when Prof. Coleman, of Toronto, ten years ago found a mountain only just more than 9000 feet high where Mount Brown should be. These giants, in the course of the explorers' four journeys, were proved to be as great impostors as the Mont Iseran and Aiguille de la Vanoise of the Graian Alps some half-century ago.

Travel in the Canadian Rockies is anything but easy work. Wood and water are the only necessaries which the country can be trusted to supply. Indians are few, and game is generally scarce, so that a loss

[1] "Climbs and Explorations in the Canadian Rockies." By Hugh E. M. Stutfield and J. Norman Collie, F.R.S. Pp. xii+343; with maps and illustrations. (London: Longmans, Green and Co., 1903.) Price 12s. 6d. net

of supplies might occasionally mean something very like starvation. Where there are any roads, these are but trails, often more than half overgrown, so that progress is apt to be slow and laborious, difficult swamps and swollen rivers have to be crossed, while mordant insects, mosquitoes and flies, are at times almost intolerable. So notwithstanding the charms of the scenery—bold peaks, fine glaciers, forest-clad slopes, and almost numberless lakelets of rare beauty—travel in the Canadian Rockies is not to be recommended to the habitués of Interlaken or Luchon. Until the Switzerland of Canada is developed—as before long it certainly will be—it can only be explored by hardy and vigorous travellers.

Game, as we have said, is scarce, but the bighorn (*Ovis Canadensis*) and the Rocky Mountain goat (*Haploceros montanus*) occur perhaps about as often as chamois in the Swiss Alps, and bears—black, brown and grizzly—are occasionally seen. Geese, ducks, and three kinds of grouse sometimes vary the *menu*, but evidently the district will hardly be tempting to sportsmen who desire "big bags." Neither do the rocks appear attractive to the palæontologist. The specimens brought back by Dr. Collie were rarely fossiliferous, even when examined under the microscope. Mr. Whymper had, on the whole, a similar experience in his explorations near and to the south of the railway, so that either subsequent mineral changes have obliterated the traces of organisms or the region in past ages was not rich in life. Dr. Collie gives an illustration of objects resembling tree trunks high up on Mount Murchison—possibly the stems of some giant alga—and picked up limestone pebbles with corals, probably Devonian or Carboniferous, in the bed of the Bush River. A few specimens contained traces of organisms, some perhaps foraminifera (misprinted foraminifer*ae*), with an ostracod (misprinted ostr*e*od); one slab showed badly preserved trilobites, probably Lower Cambrian, described by Dr. H. Woodward, and the journey of 1901 was rewarded with some remarkable tracks and other markings from Desolation Valley, south of the railway, not far from Laggan (see the *Geological Magazine* for July last).

Fig. 1.—Mount Forbes from the East. From "Climbs and Exploration in the Canadian Rockies," by H. E. M. Stutfield and Prof. J. Norman Collie.

The book is well illustrated by numerous reproduced photographs, which enable us to realise the beautiful scenery of this unfrequented land, and its topography is made clear by a map constructed from the authors' surveys. That is such as we might have expected—long troughs parallel with the general trend of the strata being connected by shorter transverse glens, as can be seen, on a smaller scale, in some parts of the Alps. In consequence of this, the Canadian Pacific Railway, as is well known, descends, west of the watershed, into a valley belonging to the Columbia system, then, after crossing a spur, strikes the same river flowing in an opposite direction, and after another mount descends to follow the Fraser River to the coast. Well illustrated and written in an attractive style, the book records a series of journeys, not always without risk, and throws much light on the geography of a region many parts of which have hitherto been very imperfectly known.

T. G. Bonney.

SCIENCE AND THE ARMY.

Many of our readers may have seen a brief preliminary official notice of the proposals of the War Office for the reform of military education. These proposals are so astonishing, in view of the facts of the case, that we take an early opportunity of directing attention to them.

There is to be, first, a qualifying test. It is intended that this shall take the form of a "leaving certificate," but in view of the probable difficulty of organising a suitable leaving examination for a long while, there seems reason to fear that, at first, this qualifying part may take the form of a special examination, which all must pass, but which will not otherwise affect the final result. This qualifying part is to consist of:—(1) English, (2) history and geography, (3) mathematics, (4) French or German, (5) either (*a*) Latin or Greek, or (*b*) science.

Then there is to be a competitive examination, in which (1) English, (2) French or German, and (3) mathematics i. will be compulsory for Woolwich candidates; and English and either French or German for Sandhurst candidates. In this examination Woolwich candidates may also offer any two of mathematics ii., science, history, French, German, Latin, Greek; and Sandhurst candidates may also offer any two of mathematics i. or mathematics ii., science, history, French, German, Greek, Latin.

The more closely we look into the probable effect of these proposals the more clearly does it appear that, under this new scheme, experimental science seems certain, by the light of past experience, to become a negligible quantity in the training of most officers. Those who read the report of the Army Education Committee published in March, 1902, may remember that the head master of Eton during the examination of a witness expressed confidently the opinion that, if Latin and science should be brought into competition in these examinations, "the science will kill the Latin." Even Dr. Warre, however, does not expect this to happen just yet, for he added, "eventually." Unfortunately for this position, we do not merely want to get a good system of army education eventually, but to get one as soon as possible,

and the figures which we quote below show how unlikely we are to get such a system under the scheme now put forward, if it be admitted, to adopt a statement taken from the report of the same committee, that experimental science, *i.e.* chemistry and physics treated experimentally, is an essential part of a sound general education. In the outlined scheme now before us—as stated above—science comes into the education of the candidates in the qualifying part as an alternative for Latin or Greek, that is to say, practically speaking, for Latin: and again in the competitive part as an alternative for Latin, French, history, &c. Now boys at school begin Latin at say eight or nine years of age. They probably rarely begin the experimental science proposed before thirteen or fourteen. If the candidates are to do a three years' course in chemistry and physics, as suggested, they must begin it at fourteen or sooner, in order to be ready for the qualifying part at, say, seventeen, which seems likely to be about the age at which we may expect most candidates will take this part. This means that at about fourteen the choice must be made between science and Latin.

But at fourteen a candidate will have studied Latin, French, &c., for years. He, his masters and his parents will know a good deal about his prospects in these subjects. Whilst, from what we have said, it is obvious that in most cases they will know nothing about his prospects in science at that age. Can it be doubted that nearly all the cleverer boys, and most even of those whose abilities are second rate, will neglect science at every stage—that, as a rule, only those who are really bad at Latin will get any science? Again, is it reasonable to suppose that candidates whose early education has included no experimental science will at the eleventh hour give up one of the subjects in which they are somewhat advanced, and take to a subject in which they are untried and untrained? Must it not happen that the average officer of the future will know nothing of, and care nothing for, science or its methods, be incapable of appreciating its importance to his profession, and incapable, even, of using the knowledge of others from ignorance of their language and methods of thought? This scheme must result most disastrously in its effect on the army and on the schools.

It has been suggested that the parents will select and insist on the science. We do not believe it. There is a strongly flowing current in favour of science among the parents. That is true. But how can any reasonable parent be expected to insist on his son taking up the subject which seems least likely to conduce to success in a competition of vital importance to him?

But this question is not really a matter of opinion at all.

Some years ago science, in both Woolwich and Sandhurst competitions, had to compete in a somewhat similar way with several other subjects which are begun earlier than the experimental science at schools, and on conditions which were, we think, not so very much more unfavourable than those now proposed. From computations that have been made for us, we find that at that time one successful Sandhurst candidate in twelve ventured to offer experimental science For Woolwich, even, though there were well-known advantages in starting at the Royal Military Academy with a scientific training, which no doubt will still exist, the proportion who offered science was only 22 per cent., or say one in five, of the whole.

As the majority of the candidates will continue for some time to come to be derived from the same classes as in the past, why should we expect a more favourable result now? Some years ago Sir Henry Roscoe and others came forward as the champions of science, and, aided by the head masters of Rugby, Cheltenham, Clifton, and other schools, and by insistently directing attention to these and similar facts, presently secured a more reasonable system in many respects. No doubt the science arrangements made then need revision now in many of their details. But the need for science training among our officers, the need for a fuller appreciation among them of the part it plays, the absolute need to start a training in science, as in languages and mathematics, at an early stage of a boy's training; and, above all, the importance of not teaching young officers to regard it as unimportant by neglecting it at the schools or afterwards, were never greater than at this moment. Who among our leaders in science will come forward in this fresh emergency?

PROF. ALEXANDER ROLLETT.

PROF. ALEXANDER ROLLETT, of the University of Graz, the eminent physiologist, died on October 1 at the age of sixty-nine. His name, though not associated with any particularly brilliant discovery, is well known to science as that of a diligent and successful worker.

Descended from a family of doctors, both his father and grandfather having been more or less distinguished physicians in Baden, near Vienna, Alexander Rollett commenced his medical studies in the dawn of the great era of physiological science under the guidance of Carl Ludwig and of Ernst Brücke, then newly appointed professor of physiology in Vienna.

In 1858, having completed his course of studies, Rollett became Brücke's assistant, and in 1863 was appointed to the professorship in Graz, which he retained until his death. Like his great masters, Rollett's investigations extended to widely different subjects, but by preference to problems that involve the use of histological methods. His principal researches may be summed up under no less than four distinct headings:—chemistry and histology of connective tissue, chemistry and histology of blood, histology and physiology of muscle, and work on sight and other senses. Three of these different subjects Rollett subsequently treated at length in several standard publications.

We find Rollett first studying the composition and structure of the connective tissues, and demonstrating that mucine is a prime constituent of these substances. His work on this subject, and especially on the cornea, he later on embodied in the corresponding chapters of Stricker's "Handbuch der Gewebelehre." He then turned his attention to the chemical and histological properties of the blood, and it was he that first performed the well-known experiment of "laking" blood by alternate freezing and thawing, and by repeated discharges of electricity. The theory of the "stroma" of the red corpuscles is likewise founded largely on Rollett's observations. By these and other discoveries he attained the rank of a prime authority on the physiology of blood, so that when Hermann edited his well-known "Handbuch," the chapter on blood fell to Rollett's share.

On the intricate subject of the structure of striated muscle Rollett brought to bear his powers of histological analysis, and added new comparative data of value by his observations on the muscles of bats, of insects, and of other invertebrates. At a much later period Rollett again approached the study of muscle from a physiological point of view, and published important observations on the velocity of the contraction wave and on exhaustion phenomena. On the

histology and physiology of muscle generally Rollett wrote in Eulenburg's "Encyclopædie." To physiological optics he contributed several papers on spatial perception, on contrast, on the effect of plane parallel glass plates, and various other subjects. He was also one of the first discoverers of sense organs in tendons, and published various observations on the sense of taste, of smell, and on cutaneous sensations.

That Rollett was no less of a teacher than of an observer is proved by the success of many of his pupils. The University of Graz acknowledged his merit by choosing him for rector no less than four different years, including the year of inauguration of the new buildings, when the Emperor and other illustrious guests were to be received. Rollett was also frequently elected as a representative on the local board, and the organisation of the new physiological institute, built under his supervision, testifies to his practical ability.

Most scientific men are naturally diffident to commit themselves in writing to a verdict on the merit of a fellow worker, but it is a curious fact that in verbal conversation this diffidence does not appear. The mere way in which the name of an observer is mentioned is often equivalent to a fairly strong expression of opinion. A careful and conscientious observer commands a degree of admiration and reverence that affects the tone of every chance remark. Judged by this standard, Alexander Rollett was a true follower of science. R. DU BOIS-REYMOND.

NOTES.

A RUMOUR has reached us that at the annual meeting of the Royal Society on Monday next an attempt is to be made by a certain section of the fellows to upset the selection of officers made last week by the council. It appears that the physiologists are under the belief that they have acquired a prescriptive right to hold one of the two secretaryships. It is true that for upwards of forty years they have so held it, but the group of natural sciences includes more than physiology or even biology, and the council, in the exercise of its discretion, has thought that it was high time that one of the other sciences should be represented in this secretaryship. We are further informed that a copy of a letter is being circulated which appears to convey an invitation from the president and council to a certain physiologist to accept the vacant office. That letter was, it is stated, written in error, without the sanction or knowledge of the president and council, but in view of it a special meeting was called to consider the matter, when the council decided to adhere to the decision at which they had already arrived in the ordinary and regular way—a decision which is obviously in the best interests of the Royal Society as a whole, and doubtless the great majority of the fellows will support it by their votes on Monday.

A CORRESPONDENT of the *Times* directs attention to the wise recognition given to science and other branches of learning by Continental nations on all occasions of national importance; and the comparison he makes with our own official customs is not creditable to our dignity. When a monarch or the supreme authority of a State visits the Court of another nation, men of "light and leading" are usually invited as guests to meet him. These are the men who give distinction to a nation; and a people which fosters intellectual accomplishments cannot conceive a State function in which they are not represented. Here, however, there is little pride in the glory which learning brings to a State, and little encouragement is given to the men who devote themselves to the advance of knowledge. Not a single writer, painter, sculptor, architect, musician or man of science of distinguished eminence was invited to Windsor or to the Guildhall to meet the King and Queen of Italy during the recent visit; and the omission, inconceivable to a foreigner, is characteristic of our customs. The *Times* correspondent concludes his letter with the following remark, with which we are entirely in sympathy:—"I believe I shall be expressing the opinion of many of my countrymen if I say that it is much to be regretted that, on great national occasions, persons of titular rank, of great wealth, or of political prominence should be considered adequately representative of the Realm, and that the arts and sciences should be ignored, as though they were non-existent among us."

SINCE the termination of the Bayliss *versus* Coleridge case, which is discussed in another part of this issue, two further communications, which appear to us as striking confirmation of the views expressed in our article, have been received by the daily papers; they are:—(1) a letter from Mr. Coleridge in which he announces that he has paid the damages (which would be interesting, had it been optional) and that he intends to continue on his former courses; (2) a letter from Mr. Bayliss, from which we learn that the large sum which he might, after having personally borne the expense and long months of worry, have used, with perfect justice, for his own advantage, has been devoted by him to the furtherance of that branch of physical science which was the object of the recent attack. Mr. Bayliss's employment of this money as a public trust is in complete consonance with the sense of public duty which has actuated his conduct throughout this matter. It will be endorsed by English physiologists and by the public as forming a worthy and fitting termination to the struggle which has been followed with so widespread an interest.

A REUTER message from Buenos Ayres announces that the Argentine war vessel *Uruguay* has arrived at Rio Gallegos with the members of the Nordenskjöld Antarctic Expedition on board. Two of the missing Swedish explorers were found on Seymour Island on November 8, and others at Snow Hill. The *Uruguay* then proceeded to Paulete Island, where the main body had wintered, and took the remaining members of the expedition on board. Dr. Nordenskjöld's expedition left Falmouth in the steam yacht *Antarctic* in October, 1901, and he expected to be home again early in the present year. From the outset of the voyage the expedition met with countless difficulties owing to the state of the ice. In December, 1902, the vessel reached the north-east coast of Louis Philippe Land, where Dr. Nordenskjöld, Lieutenant Anderson, and two sailors were left at Mount Bransfield. Dr. Nordenskjöld proposed to proceed to Snow Hill in sledges. It was arranged that Mount Bransfield should be the rendezvous for the whole expedition. The *Antarctic* meanwhile made her way to the east of Joinville Island and entered Erebus and Terror Bay. There she was caught in the ice, which finally crushed and sank her. Captain Larsen succeeded in saving all on board, and the party took to three of the ship's boats, which they equipped with provisions. They drifted about for sixteen days, and finally reached Paulete Island, where they established their winter quarters. In September, 1902, Dr. Nordenskjöld, accompanied by Lieutenant Sobral and one sailor, made a sledge journey with two sledges and five dogs in a south-westerly direction. Travelling by way of King Oscar Land, a latitude of 66 degrees was reached, the longitude being 62 degrees west. The party returned to Snow Hill at the beginning

of November, after having made a journey of more than 400 miles, in the course of which new bays and islands were found, and other discoveries were made involving important changes in the existing maps of the region. While awaiting the return of the *Antarctic*, Dr. Nordenskjöld was engaged in geological, magnetic, and meteorological observations, and got together important collections of fossils, plants, and animals. During the first winter the mean temperature was $-12°$ F. below zero, but in August it went down to $-42°$ F.

M. BORDAS, formerly assistant director of the Municipal Laboratory of Paris, has been appointed head of the laboratories of the French Minister of Finance, to succeed M. de Luynes, who is to be styled honorary director.

THE Engineering Standards Committee has appointed Messrs. Crosby Lockwood and Son as official publishers to the committee. All the reports and specifications published by the committee may be had from the official publishers or direct from the offices of the committee, 28 Victoria Street, Westminster.

AT the London Institution on Monday Sir John Gunn delivered his presidential address to the members of the Institute of Marine Engineers. The Denny medal was then presented to Mr. C. W. Barnes for his paper on ship electric lighting. The medal was founded by the late Mr. Peter Denny, of the shipbuilding firm of Denny Brothers.

A CORRESPONDENT in Paris writes that another trial of the steerable balloon *Le Jaune* was made on November 20. According to the readings of the Eiffel Tower, the wind was blowing S.S.W. with a mean velocity of 10 metres a second when *Le Jaune* left Champ de Mars at 11.25 a.m., and in a few seconds the balloon rose to a height of about 100 metres. At first the helm alone was used, and then one of the screws. The balloon soon took the direction of Chalais-Meudon, reaching its destination at 11.52 a.m.

IN moving the adoption of the report of the Government Department Committee appointed last year to inquire into the constitution, powers, and duties of the curiously named Board of Manufactures, at the recent annual meeting of the Royal Scottish Geographical Society, Sir John Murray urged the claims of science to more generous treatment. The recommendations of the committee include the reconstruction of the Board of Manufactures and the adoption of a variety of expedients to ensure better instruction in art and the improvement of the art galleries in Edinburgh. During the course of his remarks Sir John Murray said he would have liked a recommendation that certain of the buildings administered by the Board should be devoted to the purposes of science. Arrangements could, he said, be easily made for housing the Royal Geographical Society and other scientific societies, and they should all unite to secure the Edinburgh Royal Institution for science.

A DEPUTATION from the Institution of Electrical Engineers was received at Windsor on Friday last by the King of Italy and presented an address. The deputation consisted of Mr. Robert Kaye Gray, president, Lieut.-Colonel R. E. Crompton, Sir H. Mance, Dr. J. W. Swan, F.R.S., and Prof. Silvanus P. Thompson, F.R.S., accompanied by Mr. W. G. McMillan, secretary of the Institution. Telegrams were dispatched the same evening to the Associazione Elettrotecnica Italiana and to the Milan section of the Associazione, and the following replies were received from them:—"Most sensible to the feelings that inspired your kind telegram. I thank the Institution of Electrical Engineers for the new proof of sympathy, and return most hearty greetings in the name of the Associazione Elettrotecnica Italiana."—(Sd.) Ascoli. "Homage added by Institution of Electrical Engineers to enthusiastic reception to our King by all England was learned with grateful feelings by Milan Section Associazione Elettrotecnica Italiana as a new token of friendship binding Scientific bodies of the two Countries."—(Sd.) Bertini.

THE Berlin correspondent of the *Times* reports that at a meeting of the German Society of Naval Architecture held on November 20 in the technical college at Charlottenburg, a paper was read by Geheimrath Riedler on the revolutionary effect of the invention of the steam turbine upon the future of steam power. A great revolution in steam power was in progress, and the lecturer regretted that Germany lagged far behind in the adoption and development of the new motor. In a paper on the uses of the telephone for naval purposes, Herr D. Zopke, the Government constructor, gave an account of an adaptation of the so-called "stentor microphone" by means of which not only could commands be conveyed to all parts of a vessel, but the men working six guns could be directed simultaneously by a single officer. He discussed experiments made with the microphone with the object of making it give warning of the approach of hostile ships, and concluded by giving some details of the progress which had been made in Germany in the attempts to solve the problem of wireless telephony.

REFERRING to Mr. Douglas Archibald's letter on Bruckner's weather cycle, mentioned in last week's NATURE (p. 62), Dr. H. R. Mill remarks in the *Times* that the cycle does not fit the sequence of weather so satisfactorily in the British Isles as on the continents, but he urges that there must be some way to reconcile the differences, and that the subject should be taken up by some scientific society. In a letter in Tuesday's *Times* Mr. Archibald explains that according to Bruckner's studies this country happens to lie on an axis of a weather see-saw, so that east Britain alone conforms to the continental law. "Dr. Bruckner shows plainly from the past records of British stations how the law which is found to apply all over the Eurasian continent holds with somewhat diminished intensity over the eastern half of Britain, and then, after disappearing over the neutral territory of west Britain and east and middle Ireland, reappears in its opposite phase over north-west Ireland, in common with the Færöes and Iceland." In conclusion, Mr. Archibald gives the following comparison for Brussels and London to show that the Bruckner oscillation loses little in its passage across the Channel.

Total Excess or Defect of Rainfall in the Period.

	Brussels Inches	London Inches
1826–1840 [1]	− 7·20	− 6·17
1841–1855	+ 7·16	+ 4·35
1856–1870	−21·25	−11·85
1871–1885	+33·34	+19·65
1886–1902	−25·44	−29·75

[1] For Brussels the period of observation embraces 1833–1901.

WE have received some numbers of the *Journal* of the Meteorological Society of Japan. They contain several valuable papers relating, *e.g.*, to observations in the Inland Sea and North Pacific, articles on the distribution of barometric pressure in Formosa, and reduction tables. At present the text is in Japanese, but it is stated it is intended to insert articles occasionally in English, French or German. This plan will render the *Journal* much more useful to European readers. The Society was founded in 1882, and counts at present more than 200 members.

The International Aëronautical Committee (president, Dr. Hergesell) has discontinued the publication of the preliminary results of the monthly scientific balloon ascents in view of arrangements made for the speedier issue of the discussion of the definitive results. We have received, however, short summaries of the ascents undertaken by the various countries. In August Mr. Alexander's paper balloon, at Bath, attained a height of 13,000 metres. In September Mr. Dines's kite, at Crinan, N.B., reached an altitude of 2250 metres. The greatest height attained during the last three months was 20,000 metres in an unmanned balloon sent up from Strassburg.

In the *Sitzungsberichte* der Physikalisch-medicinischen Societät in Erlangen, Herr Fritz Buchner describes an interesting method of measuring the gradual falling off in the intensity of the phosphorescence of bodies excited by kathode rays. This is effected by an arrangement of rotating films, the photographic impression produced by the phosphorescent body as measured by the polarisation photometer of Martens being taken as the measure of the intensity. The author expresses the opinion that the phosphorescent light is a direct consequence of the combination of the ions produced by the action of the kathode rays to form electrically neutral molecules.

A new anti-tuberculous serum is stated to have been prepared by Dr. Marmorek, of the Pasteur Institute, Paris. By the use of a special culture medium for the tubercle bacillus, a toxin has been obtained with which horses are inoculated, and after repeated doses their blood-serum acquires antitoxic properties. The serum may then be employed for treatment, and many cases are reported to have been benefited by the injections. Dr. Marmorek is well known for his work in connection with the preparation of an anti-streptococcic serum.

In the October number of the *Journal of Hygiene* (vol. iii., No. 4) Drs. Hill and Macleod give an elaborate experimental study of caisson disease and diver's palsy, Dr. Newsholme reviews the action of English public health authorities in regard to tuberculosis, and Dr. Barclay discusses the New Zealand birth- and death-rate. The air of the House of Commons has been subjected to chemical examination by Mr. Butterfield, and to bacteriological examination by Dr. Graham Smith, from which it appears that the air breathed by our legislators is exceptionally pure. Dr. Cropper writes on the occurrence of malaria in places usually free from anopheles, and Dr. Nuttall contributes an obituary notice of the late Prof. Nocard, with portrait and list of his published papers.

In a report to the Home Office, Dr. Haldane gives an account of ankylostomiasis in the Westphalian collieries. This disease, which is due to a parasitic intestinal worm, has, since its introduction in 1895, been spreading considerably, so that in 1902 there were more than thirteen hundred cases in sixty-nine collieries. Official regulations have been drafted in order to stamp out the disease, the chief provisions of which are:—(1) no new hands may be engaged unless proved to be free from infection; (2) in every colliery at least 20 per cent. of the men shall be picked out by a specially instructed doctor, and their dejecta examined microscopically on at least three occasions; (3) any man found to be infected is subjected to a course of treatment, and is not allowed to resume work until completely freed from the worms. In the event of the examination of 20 per cent. of the men showing the mine to be infected, additional measures are taken:—(4) the whole of the men employed underground are examined, and if necessary treated; (5) every man treated is to be re-examined monthly for three months. In addition, regulations have been made for the better sanitation of the mines. The infected men are treated in hospital, and receive sickness allowance during treatment.

A Blue-book containing the official report of the preliminary conference on wireless telegraphy which was held in Berlin last August has just been published. The decisions arrived at were known some time ago, and in September last we summarised the main points in an article in these columns (Nature, vol. lxviii. p. 437). There is little to add to what was then said; the final protocol which was drawn up was signed by the delegates from Germany, Austria, Spain, the United States, France, Hungary and Russia. The delegates of Great Britain and Italy agreed to submit the proposals to their Governments with certain reserves. In the case of Italy the agreements made between the Marconi Co. and the Government greatly limit the power of the Italian Government to adopt the proposals of the conference. In Great Britain the difficulty lies in the fact that the Postmaster-General has no power over telegraphic communications beyond the limits of the territorial waters, and special legislation would therefore be required. In most of the other countries the telegraphy monopoly covers the establishment of wireless telegraph stations. When the proposals of the present conference have been considered by the various Governments a further conference will be held to establish an International Conference.

The third part of Sir C. Le Neve Foster's general report and statistics relating to the output and value of the minerals raised in the United Kingdom, the amount and value of the metals produced, and the exports and imports of minerals, has now been published. This volume deals especially with the output during 1902. The total output of coal was 227,095,042 tons, which is the largest on record; compared with the output of 1901, there is a rise of 8,048,097 tons. We consumed 166,694,908 tons in the United Kingdom, or nearly 4 tons per head of the population. 17,649,137 tons of coal were used in blast furnaces for making pig-iron. The quantity of coal exported, exclusive of coke, patent fuel, and coal shipped for use of steamers engaged in foreign trade, was 43,159,046 tons, an increase of 1,281,965 tons compared with the preceding year. If the quantities shipped for use of steamers engaged in foreign trade are added, the total amount of coal which left our shores was 60,400,134 tons, or about as much as the entire output of the kingdom half a century ago.

In a recent note (October 15, p. 578) on articles in the October number of the *Century Magazine*, the name of the yellow-fever mosquito was inadvertently given as *Culex aeniatus* instead of *Stegomyia fasciata*.

The *Transactions* of the Hull Scientific and Field Naturalists' Club for 1903 contain the article on the birds of Bempton Cliffs of which a special notice has already appeared in our columns. In a note on the dispersal of fresh-water shells by beetles, the Rev. E. P. Blackburn records the capture of several water insects with pisidia clinging to their limbs.

The report of the Albany Museum for 1902 records satisfactory progress on the part of that institution. Special interest attaches to the announcement of the discovery of a small lizard's skull from the Karoo formation, which it is proposed to call *Paliguana whitei*. This is believed to be

the only true lizard from strata of pre-Jurassic age. The specimen is to be described in the first number of a new journal, *Records* of the Albany Museum.

THE National Museum of Dublin was enriched last year by the gift of a very extensive herbarium of Irish plants, collected by the late Mr. Levinge, of Co. Westmeath. In the *Scientific Proceedings* of the Royal Dublin Society Dr. Johnstone and Miss Knowles have published a list of plants, for which the localities furnish new records, whether for the county or for other parts of Ireland.

IN the *Journal of Botany* (November) Dr. Rendle gives a description of the grass *Glyceria festucaeformis*, new to Britain, which was discovered by Mr. Praeger on the north-east coast of Ireland. This is an unexpected locality for a grass which is regarded as a Mediterranean type. In the same journal there appear two lists of mosses and hepatics, the one for Worcestershire recorded by Mr. Bagnall, the other contributed by Canon Lett of collections made in South Donegal.

IN a *Bulletin* issued by the U.S. Department of Agriculture which deals with the diminished flow of the Rock River, Mr. F. G. Schwarz discusses the question how far the water supply of a river is affected by drainage and deforestation. He contends that the actual diminution in amount is unimportant as compared with the resulting fluctuations in the flow of water, especially where the melting snow provides an appreciable source of the supply. As a remedy it is suggested that, in addition to increasing the area of forest, it would probably pay, where the land is valuable, to construct artificial reservoirs for regulating the supply of water.

THE complex series of movements which are carried out by the flowers of *Sparmannia africana*, a well-known greenhouse shrub, from the opening of the buds to the setting of the fruit has been carefully studied by Mrs. D. H. Scott, and is described in the *Annals of Botany*. In the latter part of the paper the writer gives an account of experiments which were carried out in order to show these movements by means of a kinematograph, and in which success was ultimately attained by the use of an instrument called after the maker the Kammatograph. In the Kammatograph, by means of eccentric rotation, exposures are made of successive portions of a film coated on a glass disc, so that a series of spirally arranged negatives is obtained.

THE latest Rationalist Press Association reprints, published by Messrs. Watts and Co., are John Stuart Mill's "On Liberty" and "Haeckel's Critics Answered," by Mr. Joseph McCabe. Both are published at sixpence.

MESSRS. MACMILLAN AND CO., LTD., have published in their sixpenny series "Essays Ethical and Political," by the late Prof. Huxley. The Romanes lecture delivered in 1893 on "Evolution and Ethics" is included, together with the Prolegomena written in the following year.

A NEW edition of Mr. G. Hale Puckle's "Elementary Treatise on Conic Sections and Algebraic Geometry" has been published by Messrs. Macmillan and Co., Ltd., at 7*s*. 6*d*. Alterations in the treatment of the general equation of the second degree have been made, and more simple methods of reduction and of finding the foci, eccentricities and axes are given.

WE have received the fifth half-volume of the "Natural History of Animals," by Prof. J. R. Ainsworth Davis, now being published by the Gresham Publishing Company. Previous volumes of the work have already been reviewed in these columns; the present part deals fully with animal movement in eleven chapters, running to 280 pages, and is illustrated by nearly 250 figures and three coloured plates.

THE second volume of Prof. H. Pellat's "Cours d'Électricité" has been published by M. Gauthier-Villars, of Paris, at 18 francs. The publication of the first volume, which deals with electrostatics, Ohm's law, and thermo-electricity, was announced in these columns in 1901. The present volume is concerned with electrodynamics, magnetism, the phenomena of induction, electromotors, electric oscillations, electromagnetic measurements, and similar subjects. A third volume, yet to be published, will complete the course, and will discuss electrolysis, electrocapillarity, and associated subjects.

THE additions to the Zoological Society's Gardens during the past week include a Campbell's Monkey (*Cercopithecus campbelli*) from West Africa, presented by Mr. J. F. Purser; a Macaque Monkey (*Macacus cynomolgus*, var.) from India, two African Brush-tailed Porcupines (*Atherura africana*) from West Africa, a Rose-Hill Parrakeet (*Platycercus eximius*) from Australia, deposited.

OUR ASTRONOMICAL COLUMN.

SOLAR PHENOMENA AND MAGNETIC STORMS.—In a communication presented to the Paris Academy of Sciences, M. Quenisset directs attention to the fact that, whilst the passage of a large group of sun-spots across the sun's central meridian on October 31 coincided with a terrestrial magnetic storm of exceptional activity, the passage of a much larger group on October 11 was marked by a very faint perturbation of the magnets. In explanation of this apparent anomaly he points out that the smaller group of spots was surrounded by an immense tract of faculæ, so bright that it was found possible to photograph them by the ordinary method, even when they were on the sun's central meridian, whilst scarcely any faculæ attended the larger and earlier group. From this fact M. Quenisset arrives at the conclusion, which is now becoming generally accepted, that it is the prominences and faculæ on the solar surface rather than the spots which are so closely related to terrestrial phenomena, and suggests that the monochromatic photographs of the solar surface obtained by the Hale-Deslandres method, such as are now being taken at Yerkes, South Kensington, and Meudon, will provide valuable data for the discussion of the inter-relation of solar and terrestrial phenomena (*Comptes rendus*, November 9).

OBSERVATIONS OF JUPITER.—In the November number of the *Bulletin* de la Société astronomique de France, M. Ch. Lukacs, of Budapest, publishes the results of his observations of Jovian phenomena during 1902; the following are the principal conclusions derived from the observations:—(1) The Red Spot has totally disappeared except at its eastern extremity; (2) the southern equatorial band shows remarkable activity in its northern parts; (3) the equatorial band, formerly the scene of the greatest activity of Jupiter's atmospheric forces, has now become absolutely uniform; (4) the northern equatorial band is growing gradually fainter from the south towards the north; (5) the south temperate band presents a curious depression just above the eastern extremity of the Great Red Spot, and, on August 6, two very sharply defined deviations in the course of this band were observed, the one at 125°, the other at 175° of Jovian longitude; these deviations were similar to those observed by the late Prof. Keeler on August 28, 1900; (6) the colour of the equatorial bands was a brownish ochre; the zones, generally, appeared to be of a whitish yellow, with the exception of the tropical zones, which were white, and the polar zones, which had a grey tinge mixed with yellow.

In his communication M. Lukacs gives the details of his individual observations and twelve excellent drawings of the planet as it appeared on various occasions during 1902.

THE FORMS OF THE RING AND DUMB-BELL NEBULAS.—In a recent number (539) of the *Astronomical Journal* Prof. J. M. Schaeberle stated that by using a short focus reflector he had obtained photographs of the Ring nebula which plainly showed that this object had a clockwise spiral form. In several fainter photographs obtained since, where faint nebulosities are shown only at the extremities of the major axis of the ellipse, he noticed a decided similitude in shape to the dumb-bell nebula in Vulpecula, and was induced to photograph the latter object in order to see if that, too, was a spiral; the photographs obtained show that it is, but in this case the spiral is counter-clockwise.

From these photographs of the two objects Prof. Schaeberle concludes that they were formed, in each case, by simultaneous emissions of matter from a central mass, several streams leaving the parent body in diametrically opposite directions, and with various velocities, at the same time and forming inner and outer streams of which the inner would travel round the central body several times while the outer streams were making one revolution; where these two streams meet and are superimposed, the nebulosity is much brighter, and exhibits the forms usually attributed to these objects. If we suppose that the outer boundary of the nebula, as it is usually seen, represents the exterior limit of the inner streams, and that the general arrangement of the nebula is due to gravitational forces, this theory demands that the outer streams should extend much further than is generally shown on photographs, and, in proof of this, Prof. Schaeberle has obtained photographs which show that various exterior nebulosities, and many of the adjacent faint stars, are probably part of one huge structure of which the Ring nebula is only the central condensation.

Similar proofs have been obtained to show that the formation of the Dumb-bell nebula may be explained by the same hypothesis, for on several photographs it is plainly seen that various wisps of nebulosity, which are concave towards the Dumb-bell and include several streams of faint stars, are, with the Dumb-bell, probably parts of the same original mass (*Astronomical Journal*, No. 547).

BIOLOGICAL WORK IN SOUTH AFRICA.

THE issue of the report of the Government biologist (Dr. J. D. F. Gilchrist) of the Cape of Good Hope for 1901 affords a favourable opportunity for directing attention to the energy with which biological investigations are being carried on in South Africa. Several volumes of the excellent "Fauna of South Africa," under the editorship and part authorship of Mr. W. L. Sclater, director of the Cape Town Museum, have from time to time been reviewed in our columns, where reference has likewise been made to various papers in *Marine Investigations in South Africa*, the *Annals* of the South African Museum, and other local publications. From some of these notes we venture to repeat extracts on the present occasion. It may be added that, apart from local publications, Mr. O. Thomas, of the British Museum, in papers published in the *Annals and Magazine of Natural History*, has been able to increase our knowledge of the mammals of South Africa, thanks to collections sent to this country by Colonel Slogget, R.A.M.C.

The Government biologist commences his report with an account of the trawling operations recently undertaken off the Natal coast at the request of the Government of that flourishing colony. The Natal coast is by no means promising for trawling, and as much money had been spent on previous occasions with no good results, and the recent trip proved equally unsatisfactory, the Government was advised to devote its attention to the development of line fishing, and to rely on the Cape trawling-grounds for its supply of soles. During the operations many new forms of marine life were procured, which are being investigated by specialists. On the return of the surveying vessel to Cape waters, a new trawling-ground was discovered, which promises to yield a valuable supply of food-fish.

As regards inland-fisheries, breeding operations have been seriously hampered owing to the hindrances inseparable from the institution of martial law in the country, while an unfortunate case of poisoning did not tend to mend matters. Nevertheless, the director is able to report that the rainbow-trout are in a very satisfactory condition, and that carp are likewise flourishing.

The report includes a reprint from *Marine Investigations* of Mr. R. Kirkpatrick's first paper on the sponges obtained during the Natal and Cape cruises. The third part of this contribution (*Marine Investigations*, vol. ii. part iii.) is just to hand. Several genera and many species are described as new, and the author directs attention to a notable resemblance between the sponge-fauna of South Africa and that of Australia.

A second paper reproduced in Dr. Gilchrist's report is one by Mr. G. B. Sowerby on South African molluscs, in which is described a new species of Volutilithes, making the third existing representative of that genus, which was first described from the Barton Clay. Another contribution to this subject by the same author appears in vol. ii. of *Marine Investigations*, where a number of new forms of Pleurotoma and Conus, as well as representatives of other genera, are described.

In the same volume the South African corals of the genus Flabellum receive attention at the hands of Mr. J. S. Gardiner who pays special attention to the anatomy and development of these organisms, and emphasises the importance of studying the polyp as well as the corallum if we hope to gain any real idea of their true relationships.

This volume of *Marine Investigations* also contains some valuable notes by Dr. Gilchrist on the development of South African fishes. These notes have an important bearing on certain disputed points connected with the Cape fisheries. Many fishermen urge, for instance, that the spawn of several of the commoner food-fishes is developed on or near the sea-bottom, and is, in consequence, seriously damaged by trawling. To this the author replies that, since in northern waters it has been demonstrated that only one valuable food-fish, the herring, has deep-lying spawn, and since the Cape seas are the home of only a small species of herring of little or no commercial value, it is probable that the damage done by trawling in South African waters has been overestimated.

Under the title of "Rhynchotal Miscellanea," Mr. W. L. Distant, in the *Annals* of the South African Museum (vol. ii. pt. ix. art. 12 and vol. iii. pt. ii. art. 3), publishes a series of notes on the bugs of the country, with descriptions of some new genera and a large number of new species.

In vol. iii., part iii., of the same publication, Mr. G. A. Boulenger describes six new forms of perch-like fishes from the Natal coast, all of which are illustrated in well executed plates, and belong to previously known generic types.

Part iv. art. 5 of the same volume is devoted to descriptions by Dr. W. F. Purcell of new spiders from South Africa belonging to five families.

We must likewise refer to a communication in the *Agricultural Journal* of the Cape of Good Hope for October last, in which the Government entomologist, Mr. C. P. Lounsbury, records an important discovery in regard to the propagation of the South African sheep and goat disease known as "heartwater." The bont-tick has been found to be the only medium of spreading the disease. A single specimen, if fed on a heartwater-sick animal as a larva or "seed" tick, is capable of transmitting the fatal malady. An animal pastured on veld infested by tick may drop thousands of larvæ during its illness, and thus serve for the extermination of a flock. The mortality amongst flocks brought to the coast where the tick is abundant is thus explained. Pathogenic larvæ retain their dangerous character until adult. They may take their second feeding on an ox or a non-susceptible goat, and in the final stage get on to a susceptible sheep or goat and give it fever. On the other hand, the disease appears non-transmissible through the egg-stage, and the species is normally non-pathogenic in all stages. A farm may be infested with bont-tick, yet be free from heartwater. Since the other common species are innocuous, it is hoped that by keeping down the bont-tick the disease may be stamped out.

By no means the least important memoir in the series before us is one by Mr. A. C. Seward on the fossil floras of Cape Colony, forming part i. art. 1 of the fourth volume of the *Annals*. The first section deals with the flora of the Uitenhage series, which is regarded as of Wealden rather than of Jurassic age. The Stormberg, or upper

division of the Karu, flora, on the other hand, is classed as Rhætic, while the Ecca, or lower Karu, flora is identified with some part of the Permo-Carboniferous. The latter conclusion, it may be mentioned, is rendered practically certain by the recent discovery in Kashmir of Glossopteris below marine Permian strata, as recorded in the report of the Geological Survey of India for 1902–3. The occurrence in the Ecca beds of Vereeniging of Sigillaria and other European Carboniferous types points to a closer connection between the South African Glossopteris flora and the Carboniferous flora of the northern hemisphere than exists between the latter and the Glossopteris flora of the Lower Gondwanas of India. The Ecca beds of Vereeniging appear to be the equivalents of the Karharbari beds of the Gondwanas. Finally, although deprecating a precise identification, Mr. Seward is of opinion that the Witteberg flora is probably Carboniferous or Devonian more likely the latter than the former.

That so much good work—both strictly scientific and economic—should have been accomplished during and so soon after a great war is a hopeful sign for the future of South African biology. R. L.

EXPERIMENTS ON WHEAT.

WITHIN the last few years it has gradually been recognised that, although our wheat-fields produce a large bulk of grain, it is, if used alone, unsuitable for the manufacture of the light white bread now generally demanded. In consequence, increasing quantities of the harder and more suitable wheats grown in Canada, the United States and other countries are imported yearly, and the price of the inferior home-grown grain has fallen considerably. More or less concurrently with this greatly improved methods of milling have come into vogue, and the farmer, perhaps not unnaturally, associates the two facts, and all too frequently blames the miller for his reduced margin of profit. A little closer examination of this complicated problem shows that the tendency for the last thirty years or so has been for the yield per acre of grain to rise, and the quality, as estimated by the percentage of gluten present, to fall.[1]

Now in some way or other, precisely how we do not know, the capacity of wheat to yield a strong flour, or its "quality," is bound up in this mysterious mixture of proteids grouped together as gluten, so that if the blame must be apportioned, it rests on those who injudiciously selected wheats for cropping power in preference to quality. Meanwhile, such fine old varieties as Golden Drop, Red Lammas, and Nursery wheats are steadily being driven out of cultivation by varieties slightly superior in yield, but far poorer in quality.

The great importance of making the most of our home wheat-supply has been insisted on time after time by the National Association of British and Irish Millers, and one of the methods they have suggested is to raise improved strains of these good varieties, either by hybridising or by selection. Experiments along these lines have been carried out for the last three seasons by the Cambridge University Department of Agriculture. In the first place wheats known to yield a good quality grain have been crossed together with the object of finding more vigorous races among the progeny of the hybrids. Further, varieties selected from a collection of several hundreds for possessing such characters as a strong, resilient straw, a short period of maturation, and freedom from various diseases, have also been used as parent wheats.

So far it is early to predict any results of technical value, but a number of results of scientific interest have already been arrived at in connection with Mendel's laws of inheritance. The flowers of wheat being autogamous are specially advantageous for such work, as Spielman's careful researches on wheat-breeding, carried out without any previous knowledge of Mendel's work, have shown. Spielman has already recognised that lax ears, the lack of awns, velvety chaff, and red colour are dominant characters, while dense ears, the presence of awns, glabrous chaff and white colour are the corresponding recessive characters.

These results have already been amply confirmed.

Thus from crosses between beardless and bearded wheats the resulting hybrids have invariably shown the beardless character, while their progeny have consisted of beardless and bearded forms in the proportion of three to one. Similar results have been obtained on crossing lax and dense eared races, rough and smooth chaffed, and red and white, though in the last case it has so far been impossible, owing to bad ripening, to distinguish clearly enough between red and white chaff to establish their proportions.

At the same time it has been shown that the sharply keeled glumes found in *Triticum turgidum, e.g.* are dominant over the glumes with rounded bases occurring commonly in the varieties of *T. vulgare,* that the grey colour of glumes and paleæ is dominant over red and white, that broad leaves are dominant over narrow, and rough ones over smooth, that certain groups of bristles on the ridges of the stem which distinguish some varieties are dominant over the ridges without bristles, and that hollow stems are dominant over pithy stems. With regard to grain characters, the long and narrow type is dominant over the short and round, and the red over white. At the same time certain complications have been met with which will entail further investigation. Thus the rough-chaffed grey Rivet's wheat, when crossed with a smooth-chaffed white or red wheat, gives hybrids which vary considerably both in the roughness and colour of the chaff, some being almost glabrous and showing decidedly the red or white colour as well as the grey. The same impure dominance of the rough chaff and colour is found in the following generation. Where other rough-chaffed wheats have been made use of in the place of Rivet wheat though this character has been purely dominant.

Further, particularly among the progeny of the hybrids, there is a marked tendency for the various characters to become intensified. Medium lax, for instance, becomes very lax, the grey colour becomes almost black, and the red a deep brown. At the same time, unexpected forms appear in this generation showing characters unrepresented in either parent. The commonest of these, so far, has been a spelt-like wheat with peculiarly lax ears, thick glumes, and the typically closed spikelets of *T. spelta.* Many of these exceptional forms are sterile—probably owing to imperfectly developed pollen.

These botanical characteristics are, however, of little importance technically, the farmer and miller being concerned chiefly with the quality, yield, hardiness, time of ripening, susceptibility to disease, &c., characteristics, at present practically unexamined, which one might term "constitutional."

The quality of the grain can, to a certain extent, be judged by the hardness and translucency of its endosperm, the poor starchy grain being soft and opaque. Accepting this as a guide, then, good quality is a dominant character, at all events so far as an examination of the first generation of the hybrids goes. The late ripening habit is also dominant over the early ripening habit. As an example, *T. Polonicum,* ripening early in August when sown about the middle of March, was crossed with Rivet wheat ripening late in August when autumn sown. The hybrid grains were sown on March 15, and produced plants which ripened their grain about the middle of September—simultaneously with Rivet wheat sown on the same date.

Experiments on the susceptibility to disease are also being carried out. This point is being investigated both with rusts and mildew, the two serious wheat diseases, inasmuch as they are untreatable. For the purpose of the experiment, in 1901 Michigan Bronze and a wheat with the Michigan Bronze strain in it, viz. Red King, both liable to rust, were crossed with Rivet wheat, which is practically immune. Reciprocal crosses were made in each case. The following year the hybrids were the most badly rusted plants among the experimental plots, and there was nothing to choose between the plants with Rivet wheat as male or female. Incidentally, then, it might appear to anyone who accepted Eriksson's views that in the case of Rivet wheat ♀ × Red King or Michigan Bronze ♂, the so-called "mycoplasma" had reached the hybrid grain by way of

[1] The figures are set out in detail in Girard and Lindet's "Le Froment et sa Mouture," p. 101. (Paris, 1903.)

the generative nuclei. But is such an interpretation possible? I think not.

On harvesting the plants the grain was found to be badly shrivelled, the Michigan Bronze crosses only producing three grains, none of which germinated. From about three hundred grains of the Rivet and Red King crosses, two hundred and sixty plants were raised. The rust appeared on these as early as March 16, and by June 15 many plants were orange-coloured even on the highest leaves. On counting out the plot, 78 plants were found to be free from disease, 118 were slightly infected, and 64 were badly attacked. By June 29 the epidemic seemed to be at its height, and a second count showed that the number of disease-free plants was reduced to 64, while 195 were infected, for the most part badly.[1]

These figures seem to be too close an approximation to the Mendelian ratio of 1 : 3 to be a mere accident, especially when taken in conjunction with the results of the first generation. The susceptibility of wheat to the attacks of rust is therefore a definite Mendelian character.

If further researches should show that this capacity for resisting the attacks of disease-producing fungi is in reality a tangible characteristic, the plant-breeder, at all events, will have definite lines to go upon in attempting to solve one of our most important agricultural problems, namely, that of producing disease-resisting strains.

R. H. BIFFEN.

[1] One plant overlooked.

PROBABLE ERROR IN VITAL STATISTICS.

A PAPER on "The Degree of Accuracy of Statistical Data," by Mr. Carl C. Engberg, has been published by the University of Nebraska. "This paper," Mr. Engberg tells us, "is written as a protest against the unnecessary refinement of statistical computations as carried out by the biometricians of to-day." Mr. Engberg complains that the more "prominent biometricians" have worked with five or six figures when they might have worked with three or four with equally good results. He illustrates this by comparing Prof. Pearson's work on enteric fever, published in 1894, with a revision of it by himself using only three places of decimals. He considers that the one is as good as the other. He does not, however, apply the test for relative goodness of fit of observation to theory—*Phil. Mag.*, July, 1900—but discards it without examining the analysis by which it is reached, on the basis of a paradox that he has not been able to see through. He appears to dislike the test because if 16,000 observations are distributed in the same proportions in n groups as 1000 observations the former distribution shows a lower probability for the fit than the latter, if the same curve be used in both cases. This, however, must be right. 16,000 observations should give a result nearer a smooth curve than 1000. The percentage error has been discarded for years by trained biometricians; it was merely a temporary *modus vivendi*.

As to the use of a greater or less number of decimal places, to those who work with mechanical calculators the number is practically indifferent, and to trained computators even a 7 or 10 figure table of logarithms is hardly slower in use than a 4 or 5 figure table. But are the decimal places when reached worth having? Very often not, very often they are. Mr. Engberg seems quite incapable of distinguishing between the two classes of cases. The only means of testing is to consider the probable errors of the results. The theory of the probable errors of the constants of frequency curves was not given until 1898, and it was not possible to say in 1894 how many places of decimals were or were not necessary. Mr. Engberg appears to think that because vital statistics are tabled to one or even four year units, it is impossible to ascertain the values of constants to two or three decimal places of those units. He states, vaguely, that "the constants cannot be more accurate than the data upon which they are based." He might well have asked the American actuaries for their views on this point! Practical men do not work to 6 or 10 figures for the mere pleasure of it, and in the particular case cited by Mr. Engberg—"Makeham's c"—we have a constant which has often to be raised to the fiftieth power! Does Mr. Engberg believe that the mean age at death of a population of several millions, classified solely by year of age at death, cannot be found to less than the rough year which is the basis of the grouping?

Mr. Engberg says that his "paper has not been written in a fault-finding spirit by a detractor of the new science of biometry, but by a teacher of the science." It seems a pity that Mr. Engberg should not have studied either the history or literature of the science he is teaching, or, apparently, have received a training in mathematical statistics. In the former case he would have known that the method he suggests on p. 9 has been long in use (Yule, *Proceedings* of Royal Statistical Society, vol. lx., part iv., 1897), and the inner meaning of tables of powers for testing the *last* column of high moment tables would have been obvious to him. In the latter case he would have made a valid criticism of over-many decimal places by simply showing that they gave results beyond the probable error of the constant involved, or did not improve the goodness of fit as tested by a legitimate method. We are doubtful whether the growing practice of appointing teachers of biometry in the American universities without preliminary training is really helping the science forward. It leads, it is true, to a multitude of biometric papers, but very few of these are of permanent scientific value.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—On Thursday, November 19, an election took place of great importance in relation to the advancement of the study of mental science in Oxford—that of Dr. W. MacDougall to the readership in psychology founded some years ago by Mr. Wilde. The first reader was Mr. Stout, the well-known editor of *Mind*, who last summer resigned the Oxford appointment for a professorship at St. Andrews. His successor will no doubt follow in Mr. Stout's footsteps, but those who appreciate the value of the experimental method in psychology confidently anticipate that opportunity will now be given for this study in Oxford. Dr. MacDougall has himself approached the subject from the experimental side, and is the author of very important researches on the physiology of the nervous system, among which those relating to the theory of colour vision may be taken as examples. As a member of the Cambridge Anthropological Expedition to Torres Straits and Borneo, he conducted experimental researches on the mental processes of savages, which afford substantial evidence of his power as an investigator. When to this it is added that he is no less a master of the older methods than of the new, and is regarded as a man of power alike by physiologists and by philosophers, the university may well be congratulated on so valuable an accession to its intellectual forces. Against any regret that may be felt that the new reader is not an Oxford man, the fact may be set off that one of the most successful and influential of American experimental psychologists—Prof. Titchener—received his training in both sides of the subject at Oxford.

CAMBRIDGE.—Dr. Hobson, F.R.S., has been appointed the first Stokes lecturer, and Dr. Baker, F.R.S., the first Cayley lecturer, in mathematics.

An Isaac Newton Studentship of 200*l.* a year for three years, for research in astronomy and astronomical physics, will be vacant in the Lent term, 1904. Candidates must be bachelors of arts under twenty-five years of age. Applications are to be sent to the Vice-Chancellor by January 26.

The degree of D.Litt. is to be conferred *honoris causa* on Prof. Théophile Homolle, member of the Institute of France, director of the French School of Athens.

Prof. Woodhead, Mr. J. E. Purvis, Dr. Tatham, Dr. Lane Notter, and Dr. R. D. Sweeting have been appointed examiners in State medicine for the diploma in public health.

The scheme for the establishment of a geographical school and the institution of a special examination in geography and a diploma in geography will be submitted to Senate for adoption on December 5.

PROF. WILLIAM F. DURAND, professor of marine engineering, has been appointed acting director of Sibley College, Cornell University, in succession to the late Prof. Thurston.

DR. MORRIS W. TRAVERS has been appointed professor of chemistry in University College, Bristol, in succession to Prof. Sydney Young, F.R.S. Dr. F. E. Francis, lecturer in chemistry, has been promoted to the rank of assistant professor in the college.

SPEAKING at Limerick last week in distributing prizes to the pupils of the Municipal Technical, Science and Art Schools, Sir Horace Plunkett remarked that the whole country had now taken up the work of technical education with a quickness, receptivity, and responsiveness which he was told by educational experts had not been witnessed in any country under similar economic conditions, and in so short a time. There was now scarcely a corner of Ireland where the people were not showing an anxiety and practical interest to take up a scheme which had been introduced under the auspices of the Department of Agriculture and Technical Instruction.

IN the course of an address at Liverpool on Saturday last Sir Philip Magnus remarked that our very existence as a nation depended upon our continued educational advance. There was a startling contrast between the liberal expenditure in America and Germany upon specialised university research and the small sums spent here. This country had little to learn from the method of teaching in American schools, but what we could and must learn if we were to recover lost ground was a changed attitude towards education itself. Few manufacturers in this country yet realised the economy and industrial advantages of attaching to their works intelligence departments staffed with scientific experts. He was glad to say, however, even in this respect the outlook was improving, and there were many signs of brighter days in store.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, November 19.—"The Sensation of Light produced by Radium Rays, and its Relation to the Visual Purple." By W. B. **Hardy** and H. K. **Anderson**.

When a few milligrammes of radium bromide are brought near the head in the dark a sensation of diffuse light is produced. The authors find that this is not due to any direct response on the part of the retina, the optic nerve, or the brain, but to a fluorescence of the tissues of the eyeball, notably of the lens and of the retina itself, excited by the β and γ rays.

The visual purple of the retina is not bleached by any of the radium rays.

The authors point out in passing the peculiarly high opacity of the eyelid to the rays, as compared with the skin of other parts of the body.

Physical Society, November 13.—Dr. R. T. Glazebrook, F.R.S., president, in the chair.—Sir Oliver J. **Lodge** read a paper on means for electrifying the atmosphere on a large scale. Twenty years ago the author was engaged with Mr. J. W. Clark on an investigation of the dark spaces seen near hot bodies placed in illuminated smoke. The existence of these dust-free spaces was discovered by Tyndall, and the phenomenon had been investigated by Lord Rayleigh. Tyndall worked with high temperatures, and attributed the effect to the burning of the dust near the hot body. Such, however, cannot be the case, as the spaces exist when inorganic dust, such as oxide of magnesium, is used. The conclusion at which Messrs. Lodge and Clark arrived (see *Phil. Mag.*, 1884) was that the result was due to an aërial bombardment from the hot wire which drove the particles away, and they tried the effect of electrifying the hot body to see if there was any modification of the dark space. A new phenomenon was discovered, the whole of the dust being driven to the sides of the containing vessel. This experiment was shown by the author at the British Association meeting in Montreal in 1884, and subsequently, on a larger scale, at the Royal Institution. In the latter experiment two pieces of wire gauze, connected to the terminals of an electric machine, were placed opposite each other in a smoke-filled chamber, through which a current of smoke was slowly passing. Upon electrifying the plates the smoke ceased passing, the dust particles cohered, hovered in the air, and were either driven to the sides of the chamber or fell to the bottom. In the case of mist, electrification of steam in a bell jar converted it into fine rain. It seems therefore possible that rain might be produced by the electrification of a cloud. Sir Oliver Lodge has tried at Liverpool to disperse fogs by discharging electricity into them. For this purpose a large mast was erected on the roof of the University College buildings. It terminated in a bundle of points, to which electricity was conveyed from a Wimshurst machine by a wire supported by specially constructed insulators. In order to drive electricity from a point far removed from a surface a high potential is necessary, and sometimes a large gas flame was used to supplement the points. Upon one occasion the discharge of electricity from the flame was sufficient to keep a clear space of 50 or 60 yards radius in a dense fog. The author had hoped to induce the Mersey Dock Board to try the principle on a large scale, having a series of positive discharges on one side of the river and a series of negative discharges on the other; but he felt a certain reluctance in recommending the method to practical men so long as it was necessary to derive the current from a Wimshurst machine. A dynamo would be a more suitable generator if it were possible to get a sufficiently high potential. The way out of the difficulty is to rectify a high-tension alternating current, and Sir Oliver Lodge has for some time been considering the possibility of doing this by utilising Cooper-Hewitt mercury lamps. A study of these lamps has led him to believe that their rectifying power is much assisted by the outside metallic coating which surrounds the mercury electrode, and which is connected to the positive terminal of the lamp. In order to rectify an alternating discharge, four lamps are so arranged in the form of a quadrilateral that, when the leads from the terminals of an alternating transformer are connected to two opposite corners, two unidirectional currents are obtained from the other corners. Experiments have been made at Birmingham by sending the current from a high-frequency alternator (3000 ~ per sec.) through the primary of an induction-coil and connecting the terminals of the secondary to the rectifiers. The length of the rectified spark can be increased by putting a number of lamps in series in each arm of the quadrilateral arrangement. Sir Oliver Lodge performed an experiment at the meeting to show the dissipation of fog by electrification. The current from an alternator was passed through the primary of a coil and the terminals of the secondary connected to the rectifiers, twelve lamps in all, three in series in each arm. This arrangement is capable of giving a rectified spark 2 or 3 inches long, the unidirectional nature of which can be proved by passing it through a Crookes or a Röntgen tube. Some magnesium wire having been burnt under a large bell jar to fill it with a cloud of magnesium oxide, the jar was then illuminated by the light from an electric lamp. Passing through the base-piece upon which the bell-jar was placed was a conductor which terminated in a point inside the jar. When the terminals between which the rectified discharge was passing were separated and the other end of this conductor was joined to one of them, the electricity streaming from the point into the clouded atmosphere caused an immediate deposition of the magnesium oxide.—Sir Oliver **Lodge** also described an arrangement for driving mercury pumps, designed by Mr. B. Davies and himself.

Chemical Society, November 5.—Prof. W. A. Tilden, F.R.S., president, in the chair.—The following papers were read:—The reduction of hydrazoic acid, by Mr. W. T. **Cooke**. The products were hydrazine and ammonia in place of the expected cyclic nitrogen hydride.—Preliminary note on the viscosity of liquid mixtures, by Messrs. A. E. **Dunstan** and W. H. C. **Jemmett**. The viscosity curve of a mixture of two non-associated liquids is a straight line, of a non-associated with an associated liquid, a line convex to the axes, and of two associated liquids, a line concave to the axes.—Contribution to the study of the reactions of hydrogen peroxide, by Mr. J. **McLachlan**. The evolution of oxygen induced by the addition of solutions of hydrogen peroxide to acidified solutions of potassium

bichromate or permanganate is not quantitative. Manganese dioxide reacts with hydrogen peroxide only in presence of sulphuric acid, and even then the reaction is incomplete.—The constitution of certain silicates, by Mr. C. **Simmonds.** The results obtained in a series of reduction experiments made on metallic silicates indicate that in complex silicates the silicon atoms are attached to each other, and each to two atoms of oxygen, the unappropriated oxygen atoms being those by which the metallic oxides are attached to the silica complex.—Constitution of chrysophanic acid and of emodin, by Messrs. H. A. D. **Jowett** and C. E. **Potter.** Chrysophanic acid is shown to be 5 : 8-dihydroxy-1-methylanthraquinone, and emodin either 2 : 5 : 8- or 3 : 5 : 8-trihydroxy-1-methylanthraquinone.—Conductivity of substances dissolved in certain liquefied gases, by Messrs. B. D. **Steele** and D. **McIntosh.** The conductivities of solutions of a number of substances in liquefied hydrogen chloride, bromide, iodide, sulphide, and phosphide have been determined.—The behaviour of metallic oxides towards fused boric anhydride, by Messrs. C. H. **Burgess** and A. **Holt.**—Note on some reactions of vanadium tetrachloride, by Mr. B. D. **Steele.** A description of the results obtained by the use of vanadium tetrachloride as a chlorinating and condensating agent in the synthesis of organic compounds.—Studies on comparative cryoscopy, i., the fatty acids and their derivatives in phenol solution, by, Mr. P. W. **Robertson.** It is shown that the rate of association for fatty acids (normal) rises and falls as the series is ascended, and is influenced both by the nature and position of a substituent.—Vapour pressures of sulphuric acid solutions, by Mr. B. C. **Burt.**—Additive compounds of *sym*-trinitrobenzene and alkylated arylamines, by Messrs. H. **Hibbert** and J. J. **Sudborough.**—Interaction between chloric and hydriodic acids, by Mr. J. **McCrae.** A study of this reaction, and especially of the rate at which it progresses.—3 : 5-Dichloro-1 : 1 : 2-trimethyl-$\Delta^{2 \cdot 4}$-dihydrobenzene. A correction, by Mr. A. W. **Crossley.** This compound is now shown to be the corresponding derivative of unreduced benzene.—The estimation of hydroxylamine, by Messrs. H. O. **Jones** and F. W. **Carpenter.** The method is based on the reduction of alkaline copper solutions by hydroxylamine.—A study of the isomerism and optical activity of quinquevalent nitrogen compounds, by Mr. H. O. **Jones.** A number of derivatives of the type N.R.R′R″X have been prepared, but from these no optically active isomerides could be obtained.—The influence of various substituents on the optical activity of tartramide, by Messrs. P. F. **Frankland** and A. **Slator.**—The influence of cyclic radicles on optical activity; tartaric-*ar*- and *ac*-tetrahydro-β-naphthylamides, furfurylamide and piperidide, by Messrs. P. F. **Frankland** and E. **Ormerod.** Part of a systematic examination of the relationship between rotation and chemical constitution of optically active substances.—The rotatory power of maldiamide, maldi-*n*-propylamide, and maldibenzylamide, by Mr. J. **McCrae.**—Further experiments with phosphorus sesquisulphide, by Mr. E. G. **Clayton.** The results of the application of Mitscherlich's test to specimens of phosphorus sesquisulphide which had been exposed to air under various conditions were given.

Royal Astronomical Society, November 13.—Prof. H. H. Turner, F.R.S., president, in the chair.—Mr. P. H. **Cowell** read a paper on errors in the moon's tabular longitude as affecting the comparison of the Greenwich meridian observations from 1750 with theory.—The **Astronomer Royal** read a paper on the large sun-spots of October and November, and the associated magnetic disturbances, and exhibited photographs of the sun-spots taken at the Royal Observatory, and of the magnetic tracings, showing the most considerable disturbance to have been on October 31.—Mr. Newall showed and described a series of fine spectroheliographs of the great spot-groups, taken by Prof. G. E. **Hale.**—Mr. **Newbegin** showed photographs of the November sun-spots.—Spectroheliographs of the spot-groups taken on October 9 and 31 in K light by Mr. **Evershed,** showing the flocculent masses of faculæ surrounding the spots, were also thrown on the screen.—Dr. **Lockyer** considered the correspondence of magnetic storms with solar prominences was more marked than with sun-spots, and pointed out that magnetic disturbances become more decided as the prominences approach the poles.—Father **Sidgreaves** directed attention to the work at Stonyhurst, and to his conclusion that sun-spots are not the cause of magnetic disturbances, but that both phenomena have a common cause.—Father Sidgreaves then read a paper on a spectrographic study of β Lyræ at the Stonyhurst Observatory; he exhibited slides of a series of spectra taken at different dates, and explained his theory of the changes in the light of the star.—Prof. **Turner** gave an account of a method of photographing the moon with the surrounding stars, the results of which appeared very promising. In order to reduce its light the moon was covered by an opaque screen, in which was a slit; the screen was drawn slowly across the plate, and a sufficient exposure thus given, while images were obtained of stars down to about the ninth magnitude.—Many other papers were taken as read.

CAMBRIDGE.

Philosophical Society, November 9.—Mr. A. C. Seward, vice-president, in the chair.—Exhibition of living *Gongylus gongyloides,* a floral mantis, by Captain C. E. **Williams.** The insects exhibited show the pupal or nymph stage in the development of this mantis. They were hatched from the egg about January 18 of this year, and in the ordinary course should have attained the imago or winged state at the end of October. Development appears to have been arrested by the unsuitable climate of England, and by loss of appetite under confinement. The floral mimicry is effected by the foliaceous expansion of the prothorax around the insertion of the front pair of legs. This expansion is roughly diamond or oval shaped, and on the under side is of a bright azure blue tipped with rose purple at the angles and margins; in the centre of this disc is a deeply pigmented black spot of triangular shape. The front pair of legs are held closely folded together in the front of the coloured disc. The azure coloured disc resembles a small flower, and the black spot mimics the tube of a corolla. The attitude adopted by the insect when at rest and intent on catching its prey is an inverted position below a leaf or spray of leaves, the coloured side of the prothoracic disc being turned to the brightest light available. Insects, especially butterflies, are readily attracted by the floral simulation. The hinder part of the prothorax is drawn out into a long stalk and coloured a light green, enhancing the floral resemblance. The rest of the body is shaped and coloured to resemble a bunch of dead leaves, and is practically undiscernible amid its natural surroundings. The insects exhibited were brought from Rangoon.—Experiments in wheat breeding, by Mr. R. H. **Biffen** (see p. 92).

PARIS.

Academy of Sciences, November 16.—M. Albert Gaudry in the chair.—A new method of preparation of argon, by MM. H. **Moissan** and A. **Rigaut.** The argon is prepared in four stages, the first three of which, the removal of oxygen from the air by heated copper, concentration by passing over a mixture of lime and magnesium, twice, are identical with the processes worked out by Sir W. Ramsay and Lord Rayleigh. In the fourth stage the gas, after passing over a lime-magnesium mixture, is treated with pure metallic calcium at a dull red heat. Since calcium forms a hydride stable at 500° C., this removes at one operation the last traces of nitrogen and hydrogen. The apparatus produces one litre of pure argon in twelve hours.—Mr. G. W. Hill was elected a correspondant in the section of astronomy in the place of M. Schiaparelli, elected foreign associate.—On the analytical nature of the solutions of certain partial differential equations of the second order, by M. S. **Bernstein.**—On the use of the Schrader tacheograph in hydrographic work, by MM. F. **Schrader** and Ch. **Sauerwein.**—On the extraction of oxygen by the partial liquefaction of air, by M. Georges **Claude.** A method is described in which only a portion of the air is liquefied at a low pressure, and this liquid, with any preliminary evaporation, gives a gas containing 92 per cent. oxygen, the apparatus giving about 35 cubic metres of this per hour.—The measurement of very small angles of rotation, by M. Marcel **Brillouin.** Between the two Nicol prisms is introduced a thick plate of Iceland spar with parallel faces, cut at 45° to the axis, a half-wave plate, at 45° to the principal sections of the spar, and a second plate of spar similar to the first. It is possible to measure to

a half-second of arc with this arrangement.—On the determination of maxima and minima of transparency, by M. C. **Camichel.** A modification of the Gouy spectrophotometer, in which the two Nicols are replaced by a rotating disc, partly cut away in sectors.—Some remarks on the magnetic storm of October 31, by M. Em. **Marchand.** The author concludes that during magnetic storms the currents disturbing the earth's field are situated at least partially in the upper regions of the atmosphere. The magnetic storm coincided with the passage of an important group of sun-spots across the central meridian.—On a rigorous separation of the rare earths, by MM. G. **Urbain** and H. **Lacombe.** By the addition of the double nitrate of magnesium and bismuth to the mixture of double nitrates of rare earths, each earth has as its only impurity bismuth, which is readily removed, instead of another rare earth. The method has been applied with success to mixtures of samarium and gadolinum. On kermes mineral, by M. J. **Bougault.** On the acetylenic ketones, a new synthesis of the isoxazols, by MM. Ch. **Moureu** and M. **Brachin.** Ketones of the type of acetyl-phenyl-acetylene react quantitatively upon hydroxylamine, giving isoxazols.—On the retrogradation of starch, by M. L. **Maquenne.** The retrogradation is favoured by lowering the temperature and by the presence of minute amounts of mineral acids.—The influence of the nature of the external medium on the organic composition of the plant, by MM. Alex. **Hebert** and E. **Charabot.**—On the relation between the luminous intensity and energy of assimilation in plants belonging to different biological types, by M. Fr. **Weis.**—On the structure of the cotyledons and the disposition of certain adventitious roots in young labiate plants, by M. René **Viguer.**—On polymorphism in nitrates, by M. Fréd. **Wallerant.**—On some analogies of geological *facies* between the central zone of the eastern Alps and the internal zone of the western Alps, by M. Pierre **Fermier.**—On artesian wells, by M. D. **Pantanelli.** A consideration of the influence of the pressure exerted by the rock mass upon the subterranean sheet of water upon the well level.—On a new fossil-bearing level in the Keuper beds, by MM. M. **Piroutet** and Arm. **Laurent.** A comparison of the letters of the alphabet from the point of view of the speed of writing. The formation of a rational alphabet, by MM. André **Broca** and D. **Sulzer.** The present alphabet is badly conceived from a physiological point of view. A series of signs is suggested by means of which the speed of recognition of letters could be increased one-third.—The electrical resistance of the human body, by M. Stéphane **Leduc.** The electrical resistance of the human body is especially the resistance of the skin, and this, like all electrolytes, depends on the nature and concentration of the ions it contains.—Contribution to the treatment of cancer by the X-rays, by M. **Biraud.** The disease was a typical epithelioma, and had recurred after one operation. After four months' treatment with the X-rays the pain disappeared, and the size of the tumour was reduced three-quarters. Contribution to the study of hydrochloric acid in digestion, by MM. A. **Desgrez** and J. **Adler.**

DIARY OF SOCIETIES.

THURSDAY, NOVEMBER 26.

ROYAL SOCIETY, at 4.30.—Mathematical Contributions to the Theory of Evolution, XII., On a Generalised Theory of Alternative Inheritance, with Special Reference to Mendel's Laws: Prof. K. Pearson, F.R.S.—On the Distribution of Stress and Strain in the Cross-Section of a Beam: J. Morrow.—Some Experiments in Magnetism: T. C. Porter.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—The Testing of Electric Generators by Air Calorimetry: R. Threlfall, F.R.S.—The Edison Accumulator for Automobiles: W. Hibbert.

FRIDAY, NOVEMBER 27.

PHYSICAL SOCIETY, at 5.—An Electrical Thermostat: Horace Darwin.—On the Occurrence of Cavitation in Lubrication: S. Skinner.—A Lecture Experiment in Electrical Resonance: Dr. W. Watson.

ROYAL ASTRONOMICAL SOCIETY, at 8.—Lecture by the President, Prof. H. H. Turner.

MONDAY, NOVEMBER 30.

SOCIETY OF ARTS, at 8.—The Mining of Non-Metallic Minerals: Bennett H. Brough. (Cantor Lectures. II.)

INSTITUTE OF ACTUARIES, at 5.—On the Comparative Mortality among Assured Lives of Abstainers and Non-Abstainers from Alcoholic Beverages: Mackenzie Moore.

TUESDAY, DECEMBER 1.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Discussion of Paper on the Distribution of Mean and Extreme Annual Rainfall over the British Isles: Dr. H. R. Mill.

ZOOLOGICAL SOCIETY, at 8.30.—Note upon the Tongue and Windpipe of the American Vultures, with Remarks on the Inter-relations of the Genera Sarcorhamphus, Gypagus and Cathartes: F. E. Beddard, F.R.S.—On the Mammals of Cyprus: Miss Dorothy M. A. Bate.—On the Cause of Death of a Polar Bear recently Living in the Society's Gardens.—Dr. R. N. Salaman.

WEDNESDAY, DECEMBER 2.

ENTOMOLOGICAL SOCIETY, at 8.

SOCIETY OF ARTS, at 8.—The Fiscal Problem: Sir C. M. Kennedy, K.C.M.G.

GEOLOGICAL SOCIETY, at 8.—Note on the Garnet-bearing and Associated Rocks of the Borrowdale Volcanic Series: (The late) E. E. Walker—A Contribution to the Glacial Geology of Tasmania: Prof. J. W. Gregory, F.R.S.

SOCIETY OF PUBLIC ANALYSTS, at 8.—The Characteristics of some Almond and Allied Oils: Dr. J. Lewkowitsch.—Note on the Quantitative Estimation of Mechanical Wood Pulp in Papers: C. F. Cross and E. J. Bevan.—The Estimation of Aldehydes and Ketones in Essential Oils: H. E. Burgess. Note on the Estimation of Sperm Oil: L. M. Nash.

THURSDAY, DECEMBER 3

ROYAL SOCIETY, at 4.30.—*Probable Papers*:—On the Fructification of *Neuropteris heterophylla*, Brongniart: R. Kidston, F.R.S.—Histological Studies on Cerebral Localisation: Dr. A. W. Campbell.

LINNEAN SOCIETY, at 8.—On Littoral Polychæta from the Cape of Good Hope: Dr. Arthur Willey, F.R.S.—Notes on *Myriactis Areschougii* and *Coilodesme californica*: Miss May Rathbone.

RÖNTGEN SOCIETY, at 8.30.—A New Jointless Section Wound Induction Coil, and a Flat Spiral High Frequency Apparatus: Leslie Miller.

AËRONAUTICAL SOCIETY, at 8.—Report of the International Kite Competition—(1) Mathematical Portion: Prof. C. V. Boys, F.R.S.; (2) Descriptive Portion: Eric Stuart Bruce.—Preliminary Communication on the Longitudinal Stability of Aëroplane Machines: Prof. G. H. Bryan, F.R.S., and W. E. Williams.—The Balloon Ascents made by the late Mr. James Glaisher, F.R.S., for Scientific Purposes: W. Marriott.—The Mechanical Imitation of Bird Flight: W. Cochrane.

CHEMICAL SOCIETY, at 8.—On the Molecular Formulæ of some Fused Salts as Determined by their Molecular Surface Energy: J. F. Bottomley.—Acid Salts of Monobasic Acids: R. C. Farmer.—The Atmospheric Corrosion of Zinc: G. T. Moody.—The Solubilities of the Hydrates of Nickel Sulphate: B. D. Steele and F. M. G. Johnson.

FRIDAY, DECEMBER 4.

GEOLOGISTS' ASSOCIATION, at 8.—On Land, Freshwater and Estuarine Deposits, with Special Reference to Recent Excursions; Lecture by the President, Mr. H. W. Monckton.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Artificial Draught, as Applied by Fans to Steam Boilers: W. H. A. Robertson.

CONTENTS.

THURSDAY, DECEMBER 3, 1903.

THE REFORMATION OF THE TEACHING OF GEOMETRY.

Elementary Geometry, Practical and Theoretical. By C. Godfrey, M.A., Winchester College, and A. W. Siddons, M.A., Harrow. Pp. xi+355. (Cambridge: University Press, 1903.) Price 3*s.* 6*d.*

A New Geometry for Schools. By S. Barnard, M.A., Rugby, and J. M. Child, B.A., Technical College, Derby. Pp. xxvi+514. (London: Macmillan and Co., Ltd., 1903.) Price 4*s.* 6*d.*

EIGHT years ago the writer of this review, when publishing a small book on geometry for the use of pupils of eight or nine years of age, was assured by many friends that the attempt to get rid of Euclid's order and language was a hopeless one, and that, even if it were successful, the foundations of all logical thought in England would be destroyed. Against a strong conservatism it seemed vain to point out that the great developments of modern geometry were made by European mathematicians who were not brought up on Euclid. The question had been tackled before, but with no success. When, however, the British Association and the Mathematical Association appointed committees to grapple with the matter in earnest, the victory of reform was assured. The former body thought it wise to lay down generalities, while the latter went into such minute details as to the course to be pursued by teachers, and the propositions which should be included in school instruction, that it has been possible to embody its recommendations in definite systematic treatises, such as the two excellent works the titles of which are quoted above.

That some recognised order of deduction must be established is a fact which is forced upon anyone who has to perform the part of an examiner, more especially for the public service, and the fact that there is a close agreement, not only in method, but in order, between the two works before us shows that the difficulty of dethroning Euclid is quite imaginary.

Each of these books is a vigorous protest against the extraordinary contention which we have sometimes heard, that "you must make bad figures in geometry so that the logical faculty of the pupil shall receive no assistance from them." Rule, compass, set square, and protractor are now the tools with which the young pupil begins his acquaintance with this subject; and we venture to say that, under the new system, the typical schoolboy will change his attitude of repugnance to "that beastly Euclid"; the subject will actually become popular.

The work of Messrs. Godfrey and Siddons begins with fifty-nine pages of "experimental geometry," in which the pupil is taught to draw various figures by the use of scales, compasses, &c. There is no formal list of *definitions*; the definitions are given as they are required.

Messrs. Barnard and Child open with a list of definitions, each of which, however, is illustrated by a good clear figure, and then follows part ii. of the book, which is "practical," and occupies 224 pages. This is occupied wholly by constructions, and many of these constructions are to be taken in conjunction with corresponding theorems, to which the pupil is duly referred in part iii. of the book, which is "theoretical." It must not be supposed, however, that part ii. is merely constructive—that is, that the pupil is directed to perform certain operations without understanding the reason. The constructions are, almost invariably, accompanied by a justifying proof, and the whole collection seems to be exhaustive. Here the nature of an *envelope* is also explained, and a few examples of the drawing of envelopes are given.

Under the head of constructions we find also the definitions of the trigonometrical functions, and some constructions founded thereon, so far as one angle is concerned. There is also a section dealing with the displacement of a lamina in its own plane, and the nature of the instantaneous centre of rotation. It is needless to say that the plotting of figures on squared paper and the measurement of areas thereby occupy a fair space in this section. The principles of folding and superposition, also, are largely employed as a means of proof. There is no doubt that in this work of Messrs. Barnard and Child the teacher will find every requisite for the modern teaching of geometry, including a very large number of illustrative examples. The collection of all construction propositions into one large section by themselves is the main difference between the two works before us.

In the work of Messrs. Godfrey and Siddons the constructions appropriate to each branch of the subject form a special section in that branch; thus constructions relating solely to triangles are taken together in the part of the book dealing with congruent triangles, those relating to circles in the part dealing with circles.

There is a remarkable similarity of procedure in the theoretical or deductive portions of both works. Each begins with the discussion of angles at a point, then follow the treatment of parallel lines, angles of a triangle and external angles of a polygon, congruent triangles, inequalities (*i.e.* of sides and angles of a triangle) and parallelograms, closely followed in each work by the discussion of areas.

Messrs. Godfrey and Siddons adopt the invariable plan of accompanying each proposition with a large series of examples and applications. Sometimes we come across a well chosen practical example calculated to enlist the interest and sympathy of the young pupil—such as the application of a simple case of congruent triangles to the finding of the breadth of a river, of which a figure is given. The work is a charming one, marked by great simplicity.

Squared paper and the plotting of coordinates find also ample space in this book. Geometry is supposed to have arisen from the necessities of land-surveyors, but any such mundane connection has been so long severed that we find ourselves astonished when we actually see (p. 180) an irregular figure plotted and its area estimated by a process of give and take—and this in the midst of some of Euclid's propositions, too! Truly the times have altered rapidly—a still further

proof of which fact is furnished by the liberty which each of these excellent works takes with Euclid's Prop. 19, Bk. vi.—"similar triangles are to one another in the duplicate ratio of their homologous sides"—mysterious but high-sounding to countless generations of schoolboys. Here it is, in identical words in both books, "the ratio of the areas of similar triangles, or of two similar polygons, is equal to the ratio of the squares on corresponding sides," brought down to definiteness and intelligibility at last!

There are certain time-honoured propositions in the treatment of which teachers will take a special interest, and none more prominent than Euclid's Prop. 1 of Bk. vi. Messrs. Barnard and Child prove it by assuming that the bases of the triangles are multiples of some common length, while Messrs. Godfrey and Siddons (p. 175) treat it as a mere result of the fact that the area of a triangle is half the product of a base and the corresponding perpendicular—both proofs, of course, resting on the same ultimate assumption. In justification of such proofs it may be said that no useful purpose will be effected by an early discussion of incommensurable quantities.

There are many things—such, for example, as the constancy of the product of the radii vectores from a fixed point to a circle, the nature of a tangent as a limiting position of a chord, &c.—in which we have an agreeable and useful variety of treatment in these two works, but the limitation of space renders further reference to them here impossible.

G. M. MINCHIN.

"SEMI-DARWINIAN" SPECULATIONS.

Doubts about Darwinism. By a Semi-Darwinian. Pp. vi+115. (London: Longmans, Green and Co., 1903.) Price 3*s.* 6*d.*

THE preface of this work informs us that its author has endeavoured to conform strictly to the principle laid down by Lord Kelvin, as follows:—"If a probable solution, consistent with the ordinary course of nature, can be found, we must not invoke an abnormal act of Creative Power." Unfortunately the "Semi-Darwinian's" practice is not in accord with his profession. Whenever he meets with a problem in evolution which appears to him inexplicable on the lines of natural selection, so far from seeking for "a probable solution, consistent with the ordinary course of nature," he resorts at once to the intervention, by a direct creative act, of "a Being possessing intelligence, intention and power." This is bad science, and we much doubt whether it is good theology.

Opinions have differed, and will doubtless for a long time continue to differ, as to the extent of the influence of natural selection as a factor in evolution. Darwin himself, as is well known, thought that its operation might be supplemented by that of the factors adduced by Buffon and Lamarck. Whether in view of the increase of knowledge since Darwin's day, and of the numerous cases of difficulty which have lately been satisfactorily explained on the basis of natural selection, he would have been led to discard those hypotheses that involve the hereditary transmission of acquired characters, it is, of course, impossible to say. But it certainly seems probable to those workers in whom the Darwinian tradition is strongest that their leader, were he living now, would attribute more rather than less importance to his distinctive principle of natural selection. However this may be, the fact remains that if by "Darwinism" be meant the natural selection of "accidental" variations, the doubt as to its claim to be the sole factor in evolution is a doubt that was felt by Darwin himself. Hence we demur to the title of the present work.

A matter of greater importance is the author's attempted demonstration of the impossibility of explaining certain phenomena on Darwinian principles. It is true that some of the facts he adduces have been felt as difficulties, but not, as a rule, in the way that he supposes. To answer his objections point by point would be lost labour, for he shows on almost every page that he is unacquainted with the conditions of the problem. His remarks on the subject of vision, of reproduction, of embryology, to take a few instances, are those of a disputant who has entered the lists without the necessary equipment. Argument with such an opponent is unprofitable. As an example of the failure of the "Semi-Darwinian" to master the present-day aspects of the subject, we may take his treatment of the caterpillar and beetle-stabbing instincts of Sphex and some other genera of fossorial Hymenoptera. He quotes Romanes's expression of a desire for further investigation of the facts, but appears to be quite unaware that the need has been to a great extent supplied by the labours of two industrious and accurate naturalists in America, who have put an entirely new complexion on the case as it was known to Darwin. We have no wish to detract from the merits of so zealous and patient an observer as Fabre, to whose writings those who have discussed the habits of Sphex, Ammophila, and their allies have generally been indebted for their facts; but it is impossible to study the recent work on the subject without recognising that Fabre's inferences are sometimes unwarranted. Even before the new facts had been brought forward by G. and E. Peckham, the difficulties of explanation on the lines of natural selection, though great, did not seem insuperable; they may now be said to have disappeared.

But it is not only on such points of detail as the foregoing that the author shows his absence of qualification for dealing with the modern phases of the evolutionary problem. To say nothing of other omissions, the whole series of considerations specially associated with the names of Baldwin, Lloyd Morgan and Osborn is entirely ignored by him, nor does he give any sign of being acquainted with recent views on the subject of heredity. In short, as an attack on the adequacy of natural selection, his book, besides being ineffective, is hopelessly belated.

Supposing, however, that the author's strictures were well founded; that he had really contrived to point out certain stages in the evolutionary process which are not, and apparently never can be, explained on the basis of natural selection—what then? Surely in accordance with his own canon his next step should be to search for some other natural cause of the

phenomena that baffle him. To fly at once to the hypothesis of direct "intervention" by a "higher intelligence" is as much as to say that a science of life is impossible. It is not our province to enter into the theological aspects of the matter; we would only remark that the author's language on this head appears to us to be a curious instance of survival from a bygone epoch. When, as in the eighteenth century, deistic conceptions o nature were rife, the idea of "interference" or "intervention" rose easily enough in the minds of devout persons. The only alternative seemed to be the complete banishment of the Deity from his universe. But in so far as deism is discredited by evolution, its correlative notion of "interference" must share in that discredit; and it is, to say the least of it, somewhat surprising to find the idea revived in the supposed interests of religion by one who, like the "Semi-Darwinian," professes neither to "question the general doctrine of evolution" nor to "desire to disturb the position of the 'Origin of Species' as an epoch-making book." F. A. D.

WATER SUPPLY.

Water Supply. A Student's Handbook on the Conditions Governing the Selection of Sources and the Distribution of Water. By Reginald E. Middleton. Pp. ix+168. (London: Charles Griffin and Co., Ltd., 1903.) Price 8s. 6d. net.

THE provision of a pure and ample water supply is constantly growing in importance with the development of sanitary science and the rapid increase of the population in cities and large towns; whilst adequate and unpolluted sources of supply have to be sought at greater distances away, and in a country of limited area, such as England, will before very long become difficult to obtain, yielding sufficient quantities of water to meet the growing requirements of the inhabitants. Accordingly, water supply has within recent years become one of the most universally needed branches of engineering; whereas increasing difficulties are encountered in the execution of the requisite works. The enhanced value and interest thereby conferred on works providing supplies of water, have naturally led to the publication of several books on the subject in the last few years; but the present book differs from its more elaborate and comprehensive predecessors, in dealing with principles rather than with practice, and in being intended as a sort of introduction to those larger books, and for engineering students rather than for engineers.

The first introductory chapter gives a rapid sketch, within the limits of six pages, of the various points which have to be taken into consideration in devising a scheme of water supply, from the selection of a source to the delivery of the water to the consumer; and it provides a clear and useful summary of the questions which form the subjects of the succeeding chapters. The second and third chapters deal respectively with the requirements as to the quality and the quantity of water, the former describing the mineral and organic impurities liable to be found in water, the sources rom which they are derived, and their relative importance; whilst the latter explains the variation in the daily consumption per head of population in different localities, under different conditions, at different seasons, and according to the amount of waste, also the provision necessary for increase in population, the method of measuring rainfall, the gauging of the discharge of streams and rivers, and the estimation of the available yield from the different sources of supply.

In the following chapter, on storage reservoirs, the form and construction of earthen dams, and the various arrangements resorted to for regulating the discharge of the water from the outlet of reservoirs, are the main subjects dealt with; and under the heading "Compensation Water," concluding the chapter, after explaining this important requirement, a description is somewhat irrelevantly added of the earthen embankments of the Staines reservoirs, with which the author is professionally connected, the only definite reference to an executed work given in the book. The next chapter is devoted to the calculations of stability of masonry dams by analytical methods, but a graphical treatment of the statical problems involved would be found both clearer and simpler. An interesting description is given in chapter vi. of the purification of water by the ordinary English system of slow filtration through sand; and a brief reference is made at the end of the chapter to the American system of rapid filtration by aid of a coagulant, usually aluminium sulphate, introduced into the water.

The construction of service reservoirs for providing against fluctuations in the consumption is considered in a short chapter; and it is followed by a fairly complete investigation of the flow of water through pipes, occupying twenty-seven pages. The last three of the eleven chapters in the book, relating to distribution systems, pumping machinery, and requirements in connection with waterworks, together covering less than nine pages, add more to the number of chapters and the apparent scope of the book than to actual information about waterworks, the last chapter, more particularly, consisting simply of an appeal for the collection of additional and more detailed statistics in regard to rainfall, evaporation, the discharge of rivers and streams, and other matters pertaining to water supply. The book is illustrated by four folding plates and sixty-six figures in the text, and a short index is added at the end.

Though some subjects, such as aqueducts from impounding reservoirs, water meters, and sections of typical masonry dams are not described, and the information about springs and wells is scanty, and the book, therefore, does not provide a complete account of waterworks, it gives a considerable amount of practical information, combined with valuable suggestions for the guidance of waterworks' engineers in several of the chapters. The way, however, in which the book is written renders it more likely to be used for reference than for reading straight through; and, moreover, the number of short paragraphs into which it is broken up, even when treating of a single subject, is calculated to distract the reader. Nevertheless, the engineering student will find a considerable store of useful information and valuable hints dispersed

throughout the book; and it should serve as a convenient guide for leading on students to the intelligent study of more complete and elaborate treatises on water supply.

THE MATHEMATICAL THEORY OF CRYSTAL STRUCTURE.

Mathematical Crystallography and the Theory of Groups of Movements. By Harold Hilton, M.A. Pp. xii+262; with 188 figures in the text. (Oxford: Clarendon Press, 1903.) Price 14s. net.

UNDER the fostering care of the energetic professor a small but vigorous school of mineralogy is growing up at Oxford. We are not surprised to note in the preface that it was due to Prof. Miers's suggestion that Mr. Hilton undertook the task which he has so successfully accomplished. Mr. Hilton has had a distinguished career at Oxford, and it is with pleasure we observe that a mathematician of his attainments has turned his attention to a subject which receives such scanty consideration in this country.

Mr. Hilton's book appears at an opportune moment, since it is the generally accepted idea that the geometrical theory of crystal structure has reached something like finality. A good historical account of the development of the subject is contained in the British Association Report, 1901, and the present work supplements that survey by supplying the detailed reasoning. The scope of the book is more restricted than the rather wide title would lead a reader to suppose, and it is almost wholly concerned with the symmetry and structure of crystals. With the exception of a few chapters, it follows closely Schönflies's "Krystallsysteme und Krystallstructur," but some features are introduced from the writings of Jordan, Fedorow and Barlow. Very slight allusion is made to Sohncke's work. We think it would have added to the value of the book had a page or two been devoted to his systems. Of course, they appear among the space-groups; but at the same time some Sohncke-system forms the basis of every space-group. This is Barlow's way of considering the subject, and may be found easier of comprehension by many readers, especially if the theory of groups be new to them. The book is distinguished by the fine series of diagrams of the space-groups, which have been drawn independently in the way suggested by Fedorow. The explanation of the figures, which is given on p. 171, might have been made more conspicuous so as to catch the eye more readily. The absence of such diagrams appreciably adds to the difficulty of understanding Schönflies's work.

Mr. Hilton divides his book into two parts. In the first he determines the thirty-two classes of centrosymmetry, which obey the law of rational indices and are therefore alone applicable to crystals. Another, and perhaps more logical method, is to assume that crystalline structure is cross-grained; that is to say, that a lower limit can be found to the distances between the elementary parts, whatever they may be. With this assumption, it may be shown that the only possible axes of symmetry have respectively 2-, 3-, 4- and 6-fold symmetry. The law of rational indices alone is not entirely satisfactory on account of a peculiar case of pseudotrigonal symmetry which in that way arises. This part includes an elaborate chapter on the coordinates of equivalent points, and a chapter of considerable interest on the growth of crystals.

The second part corresponds very closely to the second part of Schönflies's book. After determining the fourteen varieties of lattices, the author discusses the properties of geometrical operations and the infinite groups of movements. The dynamical flavour which unavoidably clings to the subject is unfortunate, and without a note of warning the reader may be misled into the idea that something in the nature of a movement does actually occur. On p. 159 the author proves the fundamental proposition connecting the space-groups with the corresponding point- and translation-groups, and in the succeeding six chapters he deduces the 230 space-groups belonging to the six systems. A chapter follows on the partitioning of space, with special reference to Schönflies's elementary cell.

In the next chapter, on crystal-molecules, mention is made of attempts that have been made to assign arrangements to particular substances. It may be noted that at the present day there is a tendency to regard the molecules which compose a crystal, or rather their spheres of influence, as being in contact. In that case Barlow's theory of closest-packing would have some justification. A brief historical sketch brings the book to a close.

Mr. Hilton has prepared a masterly exposition of a difficult subject, and we can heartily commend the book to the attention of crystallographers.

OUR BOOK SHELF.

Das Haar, die Haarkrankheiten, ihre Behandlung und die Haarpflege. By Dr. J. Pohl. Fifth revised and enlarged edition. Pp. 178. (Stuttgart: Deutsch Verlags Anst., 1902.)

THIS is a popular treatise upon a subject which has received too little attention from scientific observers. The first part of the work deals with the structure and development of the human hair, with a brief account of the methods of investigation. The author, with the painstaking thoroughness of the German savant, has made a large number of researches into the rate of growth and the normal fall of the hair. The common belief that cutting the hair promotes its growth is shown to be erroneous. Each hair has, on the average, a normal life of about seven years, at the end of which time it falls out and is replaced by a new one. In health there is a normal fall of hair which varies somewhat with the age of the individual.

The second part of the work is devoted to the diseases of the hair and their treatment, and to the care of the hair. The author considers that in most cases oil or pomade is beneficial, but he insists that the quantity applied must be small. The vexed question of washing the hair is discussed. In individuals in whom the scalp is healthy, Dr. Pohl is of opinion that too frequent washing is inadvisable. He advocates the use of bran, yolk of egg, and other demulcents in the water used. Rapid and thorough drying of the hair after washing is insisted upon, especially for ladies.

As an important cause of baldness in men, the author places the wearing of stiff and heavy hats, which for hours together compress the blood-vessels of the scalp and impair its nutrition and that of the hair. He points out that the common straw hat is often responsible for as much compression as the cylinder hat.

The part played by general organic and nervous diseases in causing baldness and premature greyness is considered, and these conditions obviously demand treatment at the hands of the physician. The *rôle* of micro-organisms in the production of baldness is perhaps insufficiently dealt with in the light of the work of Sabouraud and others in seborrhœa. Attention is, however, directed to the effects of the parasites of ringworm and favus. But in these diseases and in alopecia areata the patient will naturally seek medical advice.

Though the work is obviously written as a popular treatise, its perusal will be of value to the medical practitioner, who very rarely gives attention to the subject, which is one of great interest to the public, who are only too ready to fly to various nostrums brought to their attention by assiduous advertisement.

Radiant Energy. A Working Power in the Mechanism of the Universe. By R. W. O. Kestel. (Port Adelaide, 1898.)

The loose and unscientific use of terms, such as force, the curious absence of ordinary mechanical conceptions, as, for example, inertia, and the almost puerile objections raised against the Newtonian theory of planetary motion, sufficiently proclaim this book to be the work of the untrained amateur with original ideas. In consequence, none but a discerning reader will profit by its perusal. Yet the closing sentence—"Radiant Energy is a Working Power in the Mechanism of the Universe"—is a remarkable one, considering that the book is dated as having been published five years ago. The researches of Nichols and Hull in America, and Lebedew in Russia, on the pressure due to radiation have established the author's contention. In the chapter on comets some of our present notions of the cause of comets' tails are clearly anticipated, but in applying the same idea to other parts of the mechanism of the universe, the author has fallen into the error of imagining a repulsion from the sun "just thirty thousand million times too large." The main idea is that "a repelling force radiating from the sun" "partakes of the sun's motion of rotation," and "is carried round in the direction the sun is revolving." The author justifies himself by mechanical analogies, and uses the idea to account for the origin of both the orbital and axial motions of the planets. By the aid of a model in which the repulsive force is represented by a stream of horizontal water jets emanating from a rotating nozzle, many of the phenomena of planetary motion, it is claimed, can be demonstrated experimentally. The idea, although so crudely expressed, when applied to our present knowledge does seem to possess a real value. Light, radiating from the sun, should, it seems, be affected by the rotation of the sun, in such a way that the resultant of the pressures from all parts of the solar surface which reach a planet passes through a point displaced from the centre in the direction of the edge approaching the planet. The same would apply to pressure exerted by normally projected corpuscles or electrons. The effect is to produce a positive acceleration of the planet in its orbit. Whether there is also a couple acting to produce rotation suggests a nice problem for the astronomer. Is it possible that these infinitesimal pressures acting over infinite time could originate the motions of the planets? Could these pressures maintain the planet in uniform motion through a resisting ether? These problems should now admit of a definite answer, and seem worthy of a more competent analysis than the reviewer is able to give.

F. S.

Physikalisch-chemische Theorien. Von A. Reychler, nach der dritten Auflage des Originals bearbeitet von B. Kühn. Pp. xii+380. (Braunschweig: Vieweg und Sohn, 1903.) Price 9 marks.

For its compass this volume contains a wonderful amount of well-arranged material. It covers the ground usual in elementary works on physical chemistry, but by concise treatment of descriptive and theoretical matter the author finds room for much detail that has no place in other books of equal size. This gives it considerable value as an elementary work of reference, whilst it rather detracts from its suitability to the needs of the beginner.

What will probably render the book most interesting to English readers is the substitution by the author of a peculiar hypothesis of hydrolytic dissociation for Arrhenius's hypothesis of electrolytic dissociation, which, however, is duly expounded in its place. The author conceives that when a salt is dissolved in water it dissociates into the corresponding acid and base, the degree of dissociation being presumably equal to that attributed to the salt by Arrhenius's theory. The behaviour of acids and bases themselves is explained by an auxiliary hypothesis which postulates the separation from the total solvent water of a special kind of water molecule which cannot pass an osmotic membrane permeable to the other water molecules. Unfortunately the author makes no attempt to carry out his theory in detail, and so the reader is left in a somewhat dubious state of mind regarding its merits.

The author reproduces on p. 78 Traube's erroneous deduction of the degree of association of a liquid from the results of the volume method. A glance at the formula shows that it is only correct when $x=1$ or $x=2$, and is erroneous for all intermediate values.

Electrical Engineering Measuring Instruments. By G. D. Aspinall Parr. Pp. viii+328. (London: Blackie and Son, Ltd., 1903.) Price 9s. net.

Mr. Aspinall Parr has aimed at giving a description of all the leading electrical measuring instruments on the market, and he has carried out this object with a painstaking thoroughness worthy of a better cause. There can be few instruments enjoying any respectable sale which are not included in this book, and the descriptions are exceedingly clear; so also are the illustrations of the working parts, yet the reader gains little more from the book than he could gain, with perhaps a trifle more trouble, from a perusal of the makers' catalogues. "Fig. 70," to quote from the book, "shows the general appearance of this instrument with the index pointer set to 102 and the pointer clamped at zero," and Fig. 70—a picture of a brass case and a paper scale—is typical of quite 50 per cent. of the 370 excellently reproduced illustrations. The importance of instruments to electrical engineers is not to be underrated, and it is quite true, as the author says in his preface, that the literature of the subject has been neglected. But the literature that is needed is not a collation of catalogues, but something that may guide the purchaser in selecting an instrument suited to his purpose. Mr. Parr makes a point of having avoided comparison, yet this is the very thing that is wanted; in many cases one can form no idea whether the instrument is suited for high or low voltages, for large or small currents, what is its accuracy under different conditions, or what even is the general accuracy obtainable with instruments of a

given type. There is a general discussion of the theory of each class of instrument, but this is of too fragmentary a nature to be of value; we may direct attention to the fact that the discussion of hot-wire instruments is incorrect; no mention is made of the cooling of the wire, and it is apparently assumed that the instrument is kept in the circuit for exactly one second whenever a measurement is made.

It is a pity, seeing how much trouble has been taken with the drawings of the working parts and the wide acquaintance with instruments which is evidenced, that Mr. Parr has not given us a more valuable work. As it is, the book may prove useful to those who may be called upon at any time to put something right in an instrument which has broken down. M. S.

Life in Mind and Conduct: Studies of Organic in Human Nature. By Henry Maudsley, M.D. Pp. xv+444. (London: Macmillan and Co., Ltd., 1902.) Price 10*s*. 6*d*. net.

Readers of Dr. Maudsley's former volumes will find in the present work both the faults and the merits of its predecessors. Dr. Maudsley here, as always, writes with a great deal of epigrammatic felicity, and shows from time to time vivid flashes of insight into human character; here, too, as formerly, he often mars the effect of his epigrams by a tendency to re-elaborate them into rhetorical "common-places," in the technical sense of the term. The fundamental positions of the book may be reduced to three: the worlds of mind and of matter in reality form a single continuous evolution; "whatever is, is right," being an inevitable result of the laws of that evolution; "private vices" are, as Mandeville taught, "public benefits," inasmuch as vice and virtue are alike expressions of the needs of the "social organism." On this last topic Dr. Maudsley writes a great deal that is striking and not a little that is true, but he never explains how upon his principles the recognition of *any* distinction between right and wrong can be other than an absurdity. If the whole of morality is devotion to the advancement of society, and if, again, the advancement of society is *equally* promoted by virtue and by crime (and this is what Dr. Maudsley more than once asserts), why should we make any distinction between the hero and the criminal? That God brings good out of evil is a truism; it does not follow that the evil is therefore as good as the good. A. E. T.

Elementary Bacteriology. By M. L. Dhingra, M.D., C.M., Edin., D.P.H., Camb. Pp. xiv + 145. (London: Longmans, Green and Co., 1903.) Price 3*s*. net.

From the preface we learn that this little book has been written especially for Indian students and practitioners. Too much has been attempted in the space, and the descriptions suffer from extreme brevity, only the fringe of the various subjects dealt with being reached. For example, no less than sixteen disease conditions are discussed in about forty pages, excluding the space allotted to illustrations, &c. The information given, so far as it goes, is as a rule accurate, the introductory portion upon the morphology and general biology of the bacteria being perhaps the most satisfactory. Subjects of especial interest to the Indian practitioner, *e.g.* protective inoculation against cholera, receive little more attention than many others which only indirectly concern him; actinomycosis is allotted more than a page, madura disease less than half a page. In the concluding portions of the book immunity, the principles of bacteriological technique, and antivenene are similarly dealt with. The book is well and sufficiently illustrated. R. T. Hewlett.

LETTERS TO THE EDITOR.

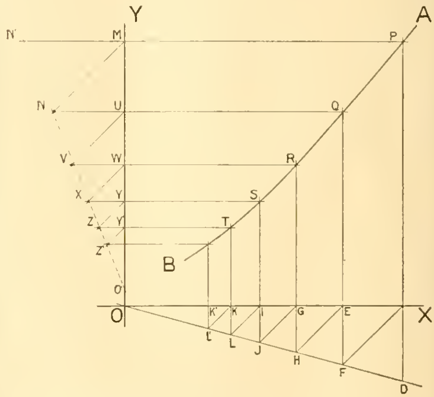
[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* Nature. *No notice is taken of anonymous communications.*]

A Useful Empirical Formula.

My note in Nature of October 8 may be extended. I found that one of my pupils, Mr. Glasgow, was assuming that the expansion and compression parts of a gas engine diagram followed laws of the type pv^n constant; in cases where there was a probability that the clearance had not been measured accurately, so that v being the measured volume and c the constant error, he assumed $p(v+c)^n$ to be constant, and he was enabled to find c from the curve. There is no reason to believe that these curves ought to have such a law, although, curiously enough, following this assumption, the clearance obtained from the compression curve is usually not very different from that obtained from the expansion curve. Mr. Glasgow's method of finding c is much the same as what I shall now describe. An empirical formula of the type

$$y = a + bx^n$$

would be exceedingly useful in many parts of pure and applied science if, when given a table of values of y and x, we could readily find a, b and n. I have often sought for a method of working, but without success. If a is zero, we have only to plot log y and log x as the coordinates of points on squared paper. If a is not zero, there is a clumsy method of using logarithmic paper which may be adopted,



but it is not satisfactory. We now have a method easy of application. Thus values of x and y being given, draw the curve AB shown in the figure. Set off any convenient angle DOX. Select the point P. Draw PD, XF, FEQ, EH, &c., the lines XF, EH, &c., being at 45°. Project horizontally from the points PQR, &c., to M, U or N, W or V, &c., letting lines at 45° from M, U, &c., meet the horizontals at N, V, X, &c. If the above law holds, N, V, X, Z lie in a straight line. If they lie only approximately in a straight line, draw the line N′O′ lying most evenly among them. Then OO′ is the value of a, and n is

$$\log(1 + \tan N'O'Y)/\log(1 + \tan DOX),$$

and b is readily found.

I may say that we have no great difficulty in testing whether a curve follows approximately a law like

$$y - \alpha = b(x - \beta)^n.$$

For this we have the curve on *tracing* paper, and we try as in the figure, then slide the curve a short distance in the direction x and try again, and so on. After a little study Mr. Glasgow has discovered a number of interesting properties of curves of these types. John Perry.

A Simple Lecture Experiment with Radium Rays.

WHILST preparing some experiments for a lecture on this matter, I found a very simple device to demonstrate the important fact that radium rays are very easily transmitted through a high vacuum; and I am not aware that it has been published before in this way. I had at my disposal the strongly acting compound of radium bromide which is prepared at Brunswick, in Germany; 10 mgr. were enclosed in a small box of ebonite with a mica cover having a diameter of 20 mm. This was put down in a Dewar's tube with vacuum jacket, as is commonly used in experiments with liquid air, and held in place by a stopper of cotton wool. The tube was then turned upside down in a little dish with some mercury, so as to obtain a perfectly enclosed space, and the radium rays could only get out by the vacuum walls or through a thick layer of mercury; by taking enough of this dense liquid the escape may be stopped altogether. Putting now a charged sensitive gold leaf electroscope at a distance of 5 cm. from the tube, a leakage instantly sets in, so as to cause the instrument to be wholly discharged in fifteen seconds. I also tried a vacuum jacketed tube with silvered walls, but though this affords much better protection against the heat rays, I did not detect any considerable difference with regard to the former experiment; the discharge was almost as quick, demonstrating that radium rays are not reflected to an appreciable amount. Even when the radium bromide was put into a large Dewar's silvered balloon of 5 litres capacity, wrapped in cotton wool, and enclosed in a wooden case, in which liquid air would be preserved during more than a fortnight, the charged electroscope came to zero in half a minute when it was placed very near to it. The experiments are effective and easily arranged.

L. BLEEKRODE.

The Hague, November 20.

Nuclei and Ions

IT is perhaps ungracious to reply to a review. I appreciate very fully that in cases of papers like mine, which take an isolated position and are written by a man who is not infallible, the task of the reviewer is burdensome enough. But Mr. C. T. R. Wilson's summary of several years of my work (October 8, p. 548) seems to me unnecessarily captious, and I am obliged to answer in self-defence.

I will not quarrel with Mr. Wilson about the titles of my papers, or about references to my first paper ("Experiments with Ionised Air"). I have had occasion to come back to it myself since (*Amer. Jour. Sci.*, xv., 105; *ibid.*, 217), and shall presumably do so again.

Turning to the second paper ("Structure of the Nucleus"), the impression given is that my first chapter is superfluous. The particular direction in which Mr. Wilson thinks it superfluous, *i.e.* the determination of reciprocal relations in the number of ions and nuclei arising in any process, I consider of special importance, as I shall explain below. Apart from this, the gist of the chapter is the (to me) very interesting result that phosphorus as a nucleator suddenly bursts forth into maximum activity at about 13°. The smoke at higher temperatures is a degradation. If I had made these experiments earlier I should not have drawn the comparison between the number of nuclei and the number of ions which Mr. Wilson impales. Recently (*Amer. Jour. Sci.*, xv., 217) I have departed widely from this early result.

With regard to my work on coronas, I had hoped that any rational attempt at systematisation would at least be tolerated. It was something, I thought, to plough through so bewildering a display and to get the general lay of the land in that deceptive colour territory, to distinguish sharply between the axial and the coronal colours, to ascertain that even in the former case the particles are large in comparison with the wave-length of light. So far as I know a discrimination of the evidence obtainable from the steam jet and the condensation chamber has thus for the first time been given. Mr. Wilson, however, has no encouragement. He gravely doubts "whether the method can be made a trustworthy one." Unfortunately I did not know this, for I have since ventured to repeat the whole work (*Amer. Jour. Sci.*, xvi., 325, and a forthcoming paper in Boltzmann's "Jubelband"), with corrections of method and calculations, obtaining suggestive periodic variations of the coronal apertures for a given colour and the sizes of the cloud particles. I have recently succeeded in catching, holding, and approximately measuring under the microscope the particles of the finest fog (beyond the largest green-blue-purple corona). Again, in a year's continuous observation by my coronal method of the atmospheric nucleation of Providence (lest this lead to "misconception," let me say that no theological bearing is implied), I have found the data useful (*Physical Review*, xvi., 193; xvii., 233).

My interpretation of the experiments on the diffusion of the nucleus is in error, but I have long since corrected it (fully in *Amer. Jour. Sci.*, June, p. 472, briefly in *Drude's Annalen*, August, p. 1144). Hence I do not find Mr. Wilson's belated comments particularly helpful. I was so fully convinced that the excessively slow diffusions observed could only be due to the motion of nuclei that I failed to see that the small coefficients of the hydrocarbon vapours would be virtually accentuated in large degree by the occurrence of diffusion from saturated to somewhat less saturated vapour. But this bad break is not of primary significance in its bearing on my work; the original purpose of these experiments with hydrocarbon vapours, which Mr. Wilson overlooks, was this:—If the ionisation accompanying nucleation is favourable to condensation, it should be particularly so, presumably, in the case of the vapour of an ionising solvent like water. Hence if non-ionising solvents like the hydrocarbons be substituted for water, the absence of effects attributable to ionisation might be discernible. No essential difference was detected.

In the following remarks relative to nuclei produced by shaking liquids, it is astonishing to find a faint note of approval, but Mr. Wilson does not intend that it shall be taken too seriously. "There is nothing new," he hastens to add, "that nuclei of this kind exist." Verbally, this may be true, but the implication of the whole paragraph is much broader. He does not point out, however, where I may find a prior succinct statement, identical with the view which I give for the persistence of the solutional nucleus.

My "extraordinary hypothesis," as Mr. Wilson calls it, is a critical alternative, put forward to ascertain whether it has been proved that ionisation has an immediate effect on condensation, or whether such condensation is not even now to be regarded as a mere question of the size of the nuclei. The hypothesis should, in the first place, be fairly stated. In any region of intense ionisation there must be a correspondingly marked tendency to synthesis. The nucleus is the stable result of this synthesis. What its structure is to be depends, therefore, primarily on the chemical ingredients of the medium out of which the nucleus is made. Given a definite medium, simple or complex, and one may anticipate a nucleus of definite size and a corresponding supersaturation needed for condensation. My contention is, then, that if nuclei are formed by the X-rays at the anode and the kathode, they are liable to be different, because the ingredients out of which the nuclei are to be compounded are different. If they do not vary in size but merely in number with the intensity of the radiation, this need be no more surprising than that the products of combustion remain the same within a wide range of temperature.

My reasons for this view may best be developed in connection with the case of phosphorus. Mr. Wilson dismisses it by stating, "The answer is simply that the nuclei causing the phosphorus clouds are not free ions like those produced by the X-rays." Let me explain why I fail to grasp the term "free ion." The phosphorus nucleus, as experiment shows, is always a relatively persistent body, while the initial ionisation is to an equal degree characteristically fleeting. Usually before the emanation has been made available for condensation, only a few per cent. of the initial ionisation is left. Meanwhile, the nucleation or condensational activity has suffered no commensurate decline (*Physical Review*, xvi., 288). It is probable that the whole series of condensations subsequently to be evoked follow in the absence of ionisation.

The case of water nuclei is in this respect almost the same, except that the initial ionisation (I shall venture to call it so, since it discharges both positive and negative

electrification; *cf. Amer. Jour. Sci.*, xv., 105) is rarely neutral as a whole. But it vanishes almost completely while the number of nuclei is relatively constant. In general, diminutions which are questions of seconds or minutes with the ions are more than questions of hours with the nuclei.

Just as in these cases there is no marked decrease of the number of nuclei while the ions all but go, so I have been unable to find any contemporaneous increase of number; and yet in my experiments with phosphorus and with water nuclei the activities of any generator for the simultaneous production of nuclei and of ions seem to increase and decrease together. I shall be able to state this more definitely at the conclusion of my present experiments on the efficiency of different types of water jets.

Finally, in my "Experiments with Ionised Air" (p. 12), I showed that in case of tests made with the steam jet, nuclei produced by the X-rays in atmospheric air were persistent in like degree with phosphorus and other nuclei. In fact, there was little difference in this respect among the nuclei examined. Nuclei produced in dust-free air, saturated either with water vapour or with hydrocarbon vapour, by the X-rays acting from without, retain the same order of persistence, whereas the ionisation is known to be fleeting. True, rubber stoppers and tubes made up a part of my condensation chamber, but in the case of water nuclei, at least, I can see no objection to this. The entire absence of electric field is always understood.

In all cases, therefore, the electrification vanishes and leaves a nucleus behind, sometimes larger, sometimes smaller. If, in any one of them, the nucleation and the ionisation vanished at the same rate, the case would be good presumptive evidence of their identity. But, to my knowledge, never does this occur. What justification is there, then, to call the phosphorus nucleus an "oxide," or if an oxide associated with ionised air, why does one not find the smaller air nuclei? I should answer that the phosphorus nucleus is the stable product of the initially ionised field. Again, why is phosphorus and dry air a more complicated system than air and water vapour under the action of the X-rays? *Out of both systems* eventually issues a stable nucleation. And why may one attribute to ionised air different condensational properties, according as positive or as negative ions are in question, without having first established that the corresponding air nuclei do not differ in size sufficiently to account for the condensational difference observed? Why may one condense on a nucleus from which the soul has fled and still be permitted to call it an ion? Why, indeed, does the nucleus persist after the ionisation has vanished; why does one not get back to dust-free air? My answer would be as in the case of phosphorus. As to water nuclei, I am much in doubt ever since I have been able to arrest the finest fog particles for examination whether the nucleus from shattered water is mere water dust. It seems to me, therefore, that electrification, if present simultaneously with nucleation, is an incidental accompaniment with no immediate bearing on the condensation produced, and for this reason I have in the above endeavoured to account for the nucleus at the outset chemically. Carl Barus.

Brown University, Providence, U.S.A.

I do not think that any worker with ions or with condensation nuclei who may have read the papers on "Experiments with Ionised Air" and on "The Structure of the Nucleus" will consider my criticism unjust.

The latter part of the letter requires some reply. According to Prof. Barus, in all cases studied by him the nuclei were distinct from the ions, persisting long after the ionisation had disappeared. All that this proves is that he has not yet succeeded in observing condensation upon the ions, but only upon nuclei of another kind. According to my experiments (*Phil. Trans.*, vol. cxciii. pp. 289–308, 1899), a fourfold supersaturation is required to cause condensation on the negative ions, a sixfold being required for the positive ions. To get such high supersaturations as these an exceedingly rapid expansion is required, and it is probable that the apparatus used by Prof. Barus is unsuitable for the purpose. In the presence of any considerable number of nuclei requiring inappreciable supersaturation (as persistent nuclei always do) to cause water to condense upon them, it must be particularly difficult to reach the supersaturation necessary for condensation upon the ions. Such persistent nuclei always were present in Prof. Barus's experiments; his failure to get condensation upon the ions was thus to be expected. His results have no bearing, therefore, upon the interpretation of my experiments on the action of the ions produced by X-rays and similar agents on condensation (for in these experiments nuclei more persistent than the ions were absent), nor of the experiments upon the charge carried by the ions made by Prof. J. J. Thomson (*Phil. Mag.*, vol. xlvi. p. 528, 1898, and vol. v. p. 346, 1903) and by Dr. H. A. Wilson (*Phil. Mag.*, vol. v. p. 429, 1903) with the same form of rapid-expansion apparatus as was used by me.

I have never been able to produce by the action of X-rays nuclei other than the ions, but possibly very intense radiation may do so, as ultra-violet light certainly does.

C. T. R. Wilson.

Cavendish Laboratory, November 23.

Weather Changes and the Appearance of Scum on Ponds.

Some experiments which I have been making during the last year seem to bear very directly upon the interesting phenomenon described by "Platanus orientalis" in your issue of November 5. These experiments show that numerous solid substances suspended or dissolved in water have, by virtue of their surface-tension relations, a marked tendency to accumulate at any surface separating water from gas (*vide Proc.* Roy. Soc., August). Hence, by merely passing a stream of air-bubbles through solutions or suspensions of certain solids in water, it is possible to effect a considerable concentration of the dissolved or suspended solid in the upper layers of the liquid. Each bubble carries with it to the surface a load of solid particles, and leaves many of them floating there either as an ultra-microscopic "pellicle" or as a visible "scum." If a bubble is very minute, its load may be so great in relation to its volume that it may be entirely unable to rise, or may even sink. If, in these circumstances, the barometric pressure be diminished, the volume of the bubble increases in greater proportion than the surface-area, and therefore than the maximum load, with the result that numerous bubbles previously unable to ascend at once begin to rise towards the surface. If, during their ascent, the barometric pressure be sufficiently increased, at once they sink. If a vessel of water containing a sediment of sulphur or calcium soap, &c., be exposed to a sufficiently diminished air-pressure, the whole of the sediment will be seen to rise to the surface, the minute air-bubbles with their coating of solid acting like so many "Cartesian Divers."

In every ordinary pond gas-bubbles of various kinds are constantly being formed by the action of micro-organisms; in nearly every pond various solid substances, both organic and inorganic, possessing the required surface-tension relations, are present both in the mud and in suspension. The gas liberated will be constantly bringing scum-forming material to the surface, whether it rises in large masses or in small bubbles. Either a fall in the barometric pressure, or a rise in temperature, or an increase in the activity of the gas-producing organisms should therefore result in increase of the scum. It must, however, frequently happen that the scum is swept to one side by the wind or sunk by various mechanical disturbances.

It would be extremely interesting to learn whether by "decided change in the weather" your correspondent means a change attended by a falling barometer.

Pembroke College, Oxford. W. Ramsden.

The "Affenspalte" in Human Brains.

Will you kindly allow me the privilege of using your columns for the following note? In a recent number of the *Anatomischer Anzeiger* Prof. Elliott Smith published a most interesting forecast of an extensive work which he has in hand, dealing particularly with the occurrence in human brains of an occipital operculum; this occurrence had been considered previously as very exceptional, but Prof. Elliott Smith is able to show that this is far from being the case.

The presence of such an occipital operculum implies the existence, in the cerebral hemisphere possessing it, of a sulcus, called by Prof. Elliott Smith the sulcus lunatus, which is strictly comparable to, if not absolutely identical with, the "Affenspalte" so typical of the brains of Simiidæ and Cercopithecidæ.

The examination of cerebral hemispheres of representatives of the lower human races is naturally suggested, and the aborigines of Australia, from several points of view, seem particularly appropriate in this connection. Following up Prof. Elliott Smith's suggestion, I have examined the brains of the aboriginal natives of Australia in the Cambridge Anatomical Museum. As a result, four out of eight hemispheres show plainly the sulcus lunatus and occipital operculum. In one case only is the condition symmetrical in the two hemispheres. The smallest brain of the four bears a sulcus lunatus and operculum on one hemisphere only. Where the sulcus lunatus is interrupted, compensation seems to be provided by deepening of the inferior occipital sulcus.

A Chinese brain in my possession has in each hemisphere a sulcus lunatus.

I shall be much obliged if you can kindly place these observations on record. W. L. H. DUCKWORTH.

November 27.

The Rate of Nerve Impulses.

DR. ALCOCK, in his recent paper at the Royal Society, finds the rate of transmission of nerve impulses in man to be 66 metres per second. Sir Michael Foster, in his "Physiology" (1888, part i. p. 76), gives it as 33 metres per second. The difference is considerable, and places us in a dilemma:—(1) either Sir Michael Foster or Dr. Alcock is widely wrong; or (2) the rate of transmission has become greatly accelerated during the last fifteen years. Of the two, the latter seems to me the simpler explanation.

W. R. GOWERS.

The Leonids of 1903.

OBSERVATIONS were begun on November 15 at 17h. 57m. and continued until daylight rendered further watching useless. In the first five and a half minutes twenty meteors appeared, all but two of which were Leonids, so that the hourly rate of the latter was 200. This period seems to have been about the time of maximum, judging from the results of other observers. Shooting stars now began to diminish in frequency, as the sky was brightening as day approached, but in the half hour comprised between 17h. 57m. and 18h. 35m. (deducting time spent in recording) thirty-six were seen, thirty-four being Leonids. Beyond 18h. 35m. the twilight was too strong to expect to detect meteors, and though the look-out was continued until 18h. 57m. no more appeared.

The display was certainly very fine, Leonids shooting one after the other in various parts of the heavens, the effect being heightened by the crescent moon and Venus, shining resplendently side by side in the south-east. Most of them were bright, the average magnitude being 1 or a little greater. As is usual with the meteors of this shower, they moved swiftly and left streaks. The prevailing colours were blue and yellow.

The radiant point, as indicated by ten registered paths, was at $148° + 22°$.

The chief observed Leonids were:—

November 15.

Time h. m.		From		To		Mag.
18 $7\frac{1}{2}$	...	$139\frac{1}{4} - 6$	...	$138 - 9$	...	>1
18 $10\frac{1}{2}$	...	$174 + 20\frac{1}{3}$	...	$179\frac{1}{2} + 19\frac{3}{4}$	...	= ♃
18 20	...	$110 + 9$	...	$106\frac{1}{2} + 7$	...	> Sirius
18 $34\frac{1}{2}$	...	$139\frac{1}{2} + 33\frac{1}{2}$	...	$132\frac{1}{2} + 38\frac{1}{2}$	...	= ♀

On the following night the sky was watched from 12h. 10m. to 14h., but though it was clear most of the time, only two Leonids were observed, and meteors generally were scarce. On November 18, from 18h. 5m. to 18h. 20m. no shooting stars appeared.

These two latter watches bring out an important fact, namely, that the shower very rapidly declined in strength after the maximum had been passed.

Sheffield, November 27. ALPHONSO KING.

ACCOMMODATION OF SCOTTISH SCIENTIFIC SOCIETIES.

IN response to a requisition signed by seven fellows, a special meeting of the Royal Society of Edinburgh was held on the afternoon of Thursday, November 26. There was a large attendance. The president, Lord Kelvin, occupied the chair; and Sir John Murray, seconded by Dr. John Horne, moved the following resolution, that

"This meeting of the Fellows of the Royal Society resolves to instruct the council to enter into formal communication with the other scientific societies having their headquarters in Edinburgh with the view of concerting measures for obtaining the use of the Royal Institution building wholly and exclusively for Scottish scientific societies."

The resolution was also supported by Prof. Cossar Ewart, Prof. Chiene, Dr. Munro, Dr. Buchan, Prof. Hudson Beare, Sir James Russell, and Prof. Chrystal. The last named, in his official capacity as secretary, referred to the history of the relation between the society and the Board of Manufactures for Scotland; while most of the other speakers spoke from the point of view of the various other societies of which they were members, such as the Royal Scottish Geographical Society, the Royal Society of Arts, the Meteorological Society, the Royal Physical Society, the Geological Society, the Mathematical Society, &c.

All who spoke were unanimous in their opinion as to the importance of the scientific societies having their rooms and libraries in one building. The advantages of such a combination are evident to all interested in the progress of science, and need not be enlarged on in these pages. But there are features peculiar to the present movement which deserve to be widely known. These were touched upon and in many cases emphasised by Sir John Murray and those who supported him.

One of the most striking architectural ornaments in Princes Street is the Royal Institution, erected in 1828. The Royal Society has always occupied the west wing of the building, and the rest is at present mainly devoted to art in the form of a statue gallery and schools of art. Several rooms are used by the officials of the Board of Manufactures, the reorganisation of which forms the subject of an important report recently made by a departmental committee specially appointed. So far as this report has to do with the Royal Society, it is in practical agreement with the claims advanced by that body, as given in the evidence of the secretary, Prof. Chrystal. These were that the society should have increased accommodation for its growing library, and should sit rent free and in perpetuity. It was pointed out by witness after witness before the committee that the building is unsuitable for art, and the committee accordingly recommends the construction of a new building for national galleries and art schools. Should the people of Scotland carry this recommendation into effect, the representatives of art will evacuate the Royal Institution, and the question will arise as to the best use to be made of the rooms. The Royal Society cannot effectively occupy the whole building, and it is under these conditions that Sir John Murray brings forward his plan for the concentration of scientific effort in the capital of Scotland. Very little internal change in the building would make it suitable for the purpose, and there is a large central hall which would serve admirably for scientific meetings of wider scope or of a popular character.

An "equivalent grant" to Scotland of 2000*l.* dates from the Union of the Parliaments, and the Board of Manufactures was appointed shortly after that time to

manage this grant and perform other incidental duties. At first this grant was devoted to the encouragement of woollen and linen manufactures, and of fisheries. Grants have also been made for scientific purposes; but latterly the money has been expended in the interests of archæology and art. In his evidence before the departmental committee, Sir Francis Mowat said that the treasury would gladly give 40,000*l.* in lieu of the 2000*l.* a year. This offer, Sir John Murray thought, should be accepted at once; for it is this 2000*l.* a year (from which science now gets no aid), which has again and again stood in the way of Scotland getting on the estimates for any scientific purpose. Were this done, the 40,000*l.*, together with other funds which have accumulated from the 2000*l.* and are now in the possession of the Board of Manufactures, could be used for building a national gallery and school of art. Although part of this sum should rightly be devoted to science, Sir John Murray was sure that all scientific men would willingly give up this right if they obtained the present Royal Institution building for their various societies.

There is not the least doubt that such a scheme would economise scientific effort, encourage scientific research, and make possible that unity and solidarity of action which is all important whenever any general scientific object is aimed at.

C. G. K.

SOME ILLUSTRATIONS OF THE MINUTE IN NATURE.[1]

THIS book is intended to bring a somewhat technical and special subject, but one of great beauty and interest, directly before the general reader. The author dissociates his subject from all scientific methods and processes, and even from the instruments by which the work is done, and is content to direct the reader of fair intelligence simply to results. These are on the whole fairly selected, and presented, pictorially and descriptively, with ability. It is not a book for microscopical workers, however elementary, for it is a mere selection of objects likely to awaken interest in minds unfamiliar with the minute in nature. As might be anticipated, it is only low and moderate magnifying power that is employed in these "revelations," but the photomicrographs are good, and give correct impressions of the objects to those who have never seen them, or are unfamiliar with the use of lenses in the study of nature.

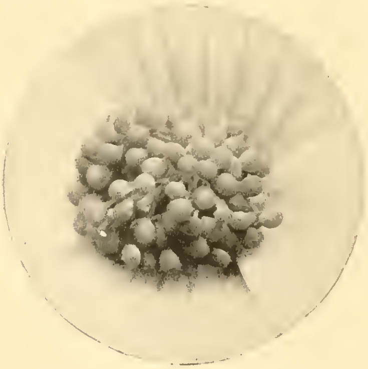


FIG. 1.—The Central Portion of a Male Begonia Flower. From "Minute Marvels of Nature," by J. J. Ward.

A great deal of space and labour is spent in dealing with the beginnings of plant life and the internal structure of plants. The illustrations devoted to the former purpose are not always competent, as that on p. 16 shows, which was intended to give an illustration of diatoms in their natural state. To a reader having no idea of what diatoms are, no enlightenment can be obtained from this photomicrograph. Many of the illustrations of diatoms are well done, and it is not at all probable that the reader will obtain from any other source photographs of the elaborate artificial arrangement of diatoms in geometric designs as they are given in this book.

FIG. 2.—Pollen-grains falling from the Stamens of one of the Mallow Flowers (magnified). From "Minute Marvels of Nature," by J. J. Ward.

The photographs illustrating plant structure are admirable, and will undoubtedly appeal to the general reader, and at the same time do much to awaken his interest in the hidden things that the microscope so readily reveals.

There is a good chapter, well illustrated, on pollen or flower dust, while some admirable illustrations and instructive writing are given the reader on the subject of insects' eggs. Some of these illustrations are of the first quality, but more care and detail would have greatly enhanced the usefulness of others of no little value in the efficient illustration of the subject. We may specialise Figs. 87 and 89, which were either inefficient photomicrographs or else processed so badly as to have made rejection a necessity. The figure giving the eggs of the small copper butterfly is excellent.

[1] "Minute Marvels of Nature," being some revelations of the microscope exhibited by photomicrographs taken by the author, John J. Ward. Pp. xxiv+272. (London: Isbister and Co., Ltd., 1903.) Price 7*s.* 6*d.*

The chapter on animal parasites is of interest, and will be eagerly perused by those for whom this book is written; so will the illustrations and descriptions of insect weapons and tools, although this chapter might with great ease have been made more popular by many added illustrations from familiar sources.

The book is well printed on good paper and admirably bound. It would make a useful and desirable present, and will, we believe, be read with pleasure by the general public, who will find that it opens a new world of facts and suggestions to them. D.

M. TSYBIKOFF'S JOURNEY TO LHASSA.

IN the latest number of the *Izvestia* of the Russian Geographical Society (1903, iii.) there is a very interesting paper, by M. G. Ts. Tsybikoff, on his journey to Central Tibet and his stay at the city of the Dalai-lama, Lhassa, the unattained goal of so many European travellers. M. Tsybikoff is a Russian Buryate by birth, and a Lamaite by religion, who studied at the Oriental faculty of a Russian university, and after having carefully prepared himself for this journey went to Tibet, as so many Buryate pilgrims do. He stayed on his way through Mongolia in two of the most renowned Mongolian monasteries, and on August 1, 1900, entered the holy precincts of Central Tibet without any difficulty. It was on the northern slope of the Bumza Pass, on the San-chu River. From this spot the caravan travelled south-westwards through the broad and open, extremely high and dry valleys of Central Tibet, where cereals are nevertheless grown by means of irrigation, and on August 16 they entered the holy city, after a three months' journey from the Gumbum Monastery, and a 370 miles' journey through Tibet proper.

At Lhassa M. Tsybikoff stayed more than twelve months, until September 23, 1901, and from that city he made an excursion so far as Tsetan, or Chetan, visiting, besides the three great monasteries situated round Lhassa—Braibun (8500 monks), Sera (5000 monks) and Galdan (2000 to 2500 monks)—also the monasteries of Dashi-lhunbo (170 miles from Lhassa, on the right bank of the Brahmaputra) and Sam-yai, on the left bank of the same river, about 67 miles south-east of Lhassa, one of the oldest in Tibet, as it was founded in the ninth century. He also visited the towns Shiha-tse, Chan-tse, and Tsetan.

The descriptions which the Russian traveller gives of Lhassa and its sanctuaries, as well as of the monasteries already mentioned, the population, its composition and its ways of living, the Government and administration, and the climate of the country—meteorological observations were made thrice a day without interruption for 235 days—are extremely interesting. The estimates of population hitherto given have been very much exaggerated, and M. Tsybikoff takes the number as not exceeding two and a half millions, out of whom one million are living in the two provinces U and Tsan. Lhassa has no more than 10,000 inhabitants, two-thirds of whom are women, its population having been overestimated on account of the 15,000 to 16,000 monks staying in the three above-named monasteries and the numbers of pilgrims.

During his stay at Lhassa M. Tsybikoff made an extremely valuable collection of 317 volumes (now in the hands of the St. Petersburg Academy of Sciences) o Tibetan books on philosophy, medicine, astronomy, history and geography, as also of prayers and incantations, written by the most renowned lamas for the last nine centuries.

The paper is illustrated by nine excellent photographs, representing views of Lhassa, the palace of the Dalai-lama, and the monasteries of Galdan and Dashi-lhunbo. The pictures are taken from the collection of M. Norzunoff, a Kalmyk pilgrim who also was at Lhassa in the same year, and brought back forty-five photographs. M. Tsybikoff's collection (twenty-one photos) reached the Russian Geographical Society after the views mentioned above had been printed.

Those who are interested in Tibet will be glad to know that, besides the diary of the Buryate Zayaeff, who visited Central Tibet in the eighteenth century, the diary of the Kalmyk Baza-bakshi Menkejieff was published in 1897, with a Russian translation by Prof. Pozdnéeff.

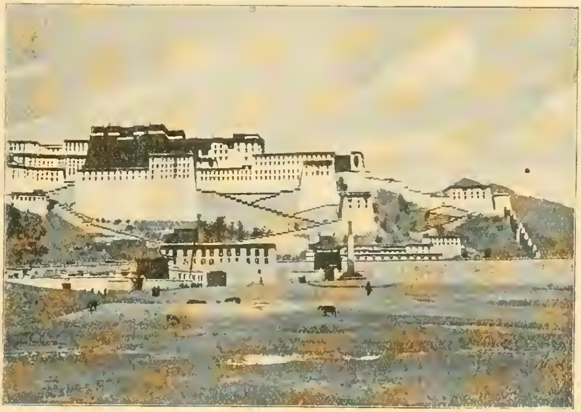


Fig. 1.—Bodala, the palace of the Dalai-lama at Lhassa, seen from the south. (It is built on the cliff Mar-bo-ri, which rises above the plain of the Ui-chu River, about two-thirds of a mile from the city itself).

ANNIVERSARY MEETING OF THE ROYAL SOCIETY.

AT the anniversary meeting of the Royal Society on Monday, the officers and council for the year were elected, the report of the council was read, and the president delivered his address. In the following list of the elected council, the names of new members are printed in italics :—

President, Sir William Huggins, K.C.B.; Treasurer, Mr. A. B. Kempe; Secretaries: Prof. Joseph Larmor and *Sir Archibald Geikie*; Foreign Secretary, Mr. Francis Darwin. Other Members of the Council: *Mr. G. A. Boulenger*, *Prof. J. R. Bradford*, Prof. H. L. Callendar, *Mr. F. W. Dyson*, Prof. H. B. Dixon, Sir Michael Foster, K.C.B., *Prof. P. F. Frankland*, *Sir Robert Giffen, K.C.B.*, *Prof. W. D. Halliburton*, *Dr. E. W. Hobson*, Prof. J. W.

Judd, C.B., Prof. G. D. Liveing, Prof. A. E. H. Love, *Mr. Adam Sedgwick, Dr. W. N. Shaw*, Capt. T. H. Tizard, R.N., C.B.

The report of the council refers, among other matters, to the work of the National Physical Laboratory and the scientific results obtained, the International Association of Academies, the International Catalogue of Scientific Literature, International Aëronautics, and sleeping sickness.

In February last, Lieut.-Colonel Bruce, F.R.S., went to Uganda to study sleeping sickness, with Dr. Nabarro as bacteriologist. Soon after their arrival, Dr. Castellani, who was then in Uganda, reported to Colonel Bruce that during the past five months he had observed trypanosomes in the cerebro-spinal fluid of cases of sleeping sickness, and a telegram was received from Colonel Bruce in April stating that he considered it very probable that a trypanosome was the cause of the disease.

Since then a report entitled "Progress Report on Sleeping Sickness in Uganda" has been received and published as No. 2 Report of the Sleeping Sickness Committee.

Colonel Bruce returned to England in September, bringing with him a further report which adduces evidence that—

(1) Sleeping Sickness is caused by the entrance into the blood, and thence into the cerebro-spinal fluid, of a species of trypanosoma.

(2) This species is probably that discovered by Forde and described by Dutton from the West Coast of Africa, and called by him *Trypanosoma Gambiense*.

(3) The so-called cases of trypanosoma fever, described from the West Coast, may be cases of Sleeping Sickness in the earliest stages.

(4) Monkeys are susceptible to Sleeping Sickness, which in them produces the same symptoms, and runs the same course, whether the trypanosomes injected are derived from cases of so-called trypanosoma fever, or from the cerebro-spinal fluid of cases of Sleeping Sickness.

(5) Dogs and rats are partially susceptible, but guinea-pigs, donkeys, oxen, goats, and sheep, up to the present, have shown themselves absolutely refractory.

(6) The trypanosomes are transmitted from the sick to the healthy by a species of tsetse fly, *Glossina palpalis*, and by it alone.

(7) The distribution of Sleeping Sickness and *Glossina palpalis* correspond.

(8) Sleeping Sickness is, in short, a human tsetse fly disease.

In the course of his address, the president referred to the portrait of Lord Rayleigh, painted by Sir George Reid, which was formally presented to the society at Monday's meeting, and to the retirement of Sir Michael Foster, the senior secretary. A large part of the address was devoted to suggestions which have been made to affiliate important special or local societies with the Royal Society. A committee appointed to consider the question some time ago decided that the Royal Society, both as to its administration and work, should remain as heretofore, and not enter into any formal relationship with special societies. Support was, however, given in the address to the need of integration in respect of publications of the Royal and other scientific societies. The joint publication of papers was brought before the council several years ago, but was not received with favour. It has since been found to work successfully with the Royal Astronomical Society, and the opinion is expressed that other societies might arrange for the duplicate publication, in their own *Transactions*, of papers communicated to the Royal Society of special interest to the respective special societies. This plan leaves each society to its complete independence, and does not involve the Royal Society in any obligation which would in any way interfere with its own free administrative working.

The work of this year's medallists was described in the address as follows:—

Copley Medal.

The Copley Medal is awarded to Prof. Edward Suess, For. Mem. R.S., in recognition of his eminent services to Geology, and especially of his original researches and conclusions published in his great work, "Das Antlitz der Erde."

Prof. Suess was for 40 years Professor of Geology in Vienna University, and under his guidance a school of Geology has arisen, which is not surpassed in any country of the world. He has written numerous papers on Stratigraphical and Physical Geology, and has published much valuable palæontological work. The results of many years of study were contained in "Die Entstehung der Alpen," published in 1875. In this book he traced the geological history of the Central European ranges, and applied the results of his inquiry to the problems of mountain formation and surface contours in general. This work was followed, in 1885, by the first volume of "Das Antlitz der Erde," in which the same problems were attacked on a wider field. The second volume was published in 1888, but the first part of the third volume was not issued until 1901. In this great work the study of the changes that have taken place during geological times in the oceans and seas of the globe is combined with inquiry into alterations in the form of the solid surface. Owing to the wonderful grasp of the subject, and the striking originality shown, the work has influenced geological thought to an extent that has seldom been equalled.

Many geologists have distinguished themselves by mastering the geological structure of different countries, small or large, or have devoted their energies to the solution of particular problems; Suess has aimed at giving an explanation of the surface features exhibited by the whole world, founded on an investigation of its geological history. The forms of continents and islands, the distribution and direction of mountain ranges, the profiles, contours, and histories of the great oceans—all are treated by him with a master's hand. "Das Antlitz der Erde" represents the culmination of the Geology of the nineteenth century; as has been most aptly said by Marcel Bertrand in his preface to the French translation, it is the last term of the revolution commenced a century ago by Werner and Hutton.

Royal Medal.

A Royal Medal is awarded to Sir David Gill, K.C.B., F.R.S., for his researches in Solar and Stellar Parallax, and his energetic direction of the Royal Observatory at the Cape of Good Hope.

Sir David Gill (H.M. Astronomer at the Cape Observatory since 1879) is specially distinguished for his researches on the distances of the heavenly bodies, although his other work has covered a large field. He has made four independent determinations of the sun's distance by heliometer observations of Mars (1877), Iris (1888), Victoria (1889), and Sappho (1889), being ably assisted in some of these investigations by others, but undertaking the greater part of the work himself. The four determinations agree wonderfully well in giving a solar parallax very near 8″·80, which has consequently been adopted for general use in national Ephemerides since the beginning of the present century. Incidentally this work gave improved values for other constants of the solar system, especially the lunar equation in the sun's motion; and it suggested that the time had arrived for an entirely new method of observing the places of the planets, which Sir David Gill has since initiated.

He has also determined the parallaxes of eleven stars of the first magnitude, and four stars of larger proper motion; and several similar determinations carried out by others have been inspired by Sir David Gill. And he has discussed the results from a cosmical point of view. In such work he takes a first place among astronomers.

In addition to these researches of the normal type, Sir David Gill, by his energy and enterprise, has placed the Cape Observatory in the front rank; so that for the first time in the annals of Astronomy we have now at length an observatory of the highest class in the Southern Hemisphere. He has brought up to date the current reductions, and has produced several valuable catalogues of stars, in which particular attention has been paid to the elimination of small errors, notably the "magnitude-equation," to

which Sir David Gill was himself the first to direct attention. And he has completely photographed, on a moderate scale, the Southern Hemisphere. The plates were measured in Holland by Kapteyn, who has published the results recently in a valuable work, the "Cape Photographic Durchmusterung," for which Kapteyn received the Royal Astronomical Society's Gold Medal in February, 1902. It may be recalled that on that occasion Kapteyn expressed very warmly his indebtedness to Sir David Gill.

Sir David Gill had a large share in initiating the International Astrographic Chart; he has also been very active in superintending the Geodetic Survey in South Africa.

Royal Medal.

The other Royal Medal is conferred upon Dr. Horace T. Brown, F.R.S., for his work on the chemistry of carbohydrates, and on the assimilation of carbonic acid by green plants.

His memoir (H. T. Brown and G. H. Morris, *Journ.* Chem. Soc., 1893) on the "Chemistry and Physiology of Foliage Leaves" is of value as confirming the rougher work of Sachs on the amount of carbohydrate assimilated per leaf area per unit of time, but especially as being the first thorough investigation into the manufacture and translocation of the various sugars in the green leaf. This paper also contributes to our knowledge of the action of diastase in the leaf; and in this connection may be mentioned the paper on the "Germination of the Gramineæ" (H. T. Brown and G. H. Morris, *Journ.* Chem. Soc., 1890), which is a valuable contribution to the study of diastase and other enzymes.

His Presidential Address to the Chemical Section of the British Association, 1899, gave an account of work of the highest interest to botanists, such as the relation between the amount of assimilation of carbon and the partial pressure of the carbonic acid in the atmosphere, and the rate of absorption of carbonic acid by a leaf, as compared with the absorption by a solution of caustic alkali. These and other points are developed in the memoir on "Static Diffusion of Gases and Liquids in Plants" (H. T. Brown and F. Escombe, *Phil. Trans.*, 1900), which is one of the most important works on assimilation by plants that we possess. In this remarkable essay, Brown develops the principles determining the amount of diffusion from gases and solutions into absorbing surfaces, and shows that leaves conform in the size and number of the stomata to absorbing surfaces of high efficiency.

The earliest important chemical work of Horace Brown was on the influence of pressure on fermentation. He discovered that other gases besides carbonic acid were given off in the fermentation of malt worts and of grape sugar, and that the hydrogen evolved increased as the pressure was diminished. The formation of acetic acid during the fermentation out of contact with air was shown to be due to a direct transformation of the sugar into acetic acid.

In conjunction with Heron and Morris, he made a series of valuable investigations into the nature of starch and its transformations. He showed that the action of malt extract upon soluble starch might be represented by the *successive* removals of maltose by hydration (hydrolysis), the successively formed residues being a series of dextrins.

He was the first to apply Raoult's freezing-point method to the systematic determination of the molecular weights of the carbohydrates, and his measurements showed that soluble starch was much more complicated than the dextrins derived from it, the starch molecule possibly consisting of four complex amylin-groups arranged round a similar fifth group. But later work on dextrinic acid led to the view that the starch molecule is made up of the residues of 80 *maltan* groups and 40 *dextran* groups, linked in ring form through oxygen atoms, and that the maltan portion of the ring is attacked by successive stages of hydrolysis, forming dextrins and finally maltose. The molecular weight of starch cannot be less, according to these experiments, than 32,400.

The investigation of "secondary fermentation" produced by a small quantity of dried hops in beer led to his important work on the chemistry and physiology of foliage leaves, in which he gives reasons for supposing that cane-sugar is the first sugar to be synthesised by the assimilatory processes, and that this is the starting point of the metabolic changes in the leaf.

The discovery of the solution of the cell-membranes of grass seeds by a cellulose-dissolving enzyme secreted in the epithelium led him to investigate the corresponding action on the cell-walls of starch granules in the processes of animal digestion. After exhaustive experiments, he concluded that the cell-walls were attacked by an enzyme pre-existent in the grain.

Davy Medal.

The Davy Medal for the most important discovery in chemistry is awarded to M. Pierre Curie, and Madame Curie, Docteur ès Sciences, for their researches on radium.

The discovery of radium—whether it be regarded from the point of view of the extraordinary properties of that substance, unique in their intensity if not in their kind, or of the undeviating aim and invincible patience with which the clue to its separation has been skilfully followed, or of the extended, even revolutionary, views of the constitution of matter and of the stores and transformations of energy in Nature which the study of its properties is opening up to us—may well be characterised as the most important discovery in chemistry of the present time.

Hughes Medal.

The Hughes Medal is awarded to Prof. Johann Wilhelm Hittorf for his experimental researches on the electric discharge in liquids and gases, extending over a period of more than half a century into the present year.

The results of his work have been published in a series of papers, of which the first, on the electric conductivity of mercury, appeared in *Poggendorff's Annalen* so long ago as 1851, and was followed, in the years 1853 to 1859, by others, giving an account of his masterly investigations of the migrations of the ions in electrolysis. In conjunction with Plücker he took up the examination of the spectra emitted by gases under the influence of electric discharges from an induction coil, and communicated the results to the Royal Society in 1864; and in the ensuing twenty years he published, from time to time, a number of papers on electric conductivity in gases, which have greatly contributed to the advancement of our knowledge of that subject. In 1898 and 1899 he published papers on the electromotive behaviour of chromium and on the passive state of metals, and in the three years of the present century further papers on the rates of motion of the ions.

It is now the jubilee of the publication of his first paper on the last-named subject, a paper which marks an epoch in our knowledge of electrolysis. In that paper, and those which followed it in the next five years, by his careful measurements of the movements of the ions in a great variety of cases, he laid a solid foundation on which subsequent investigators have reared a large superstructure. The view of the constitution of electrolytes, and of chemical compounds in general, to which his research directly led, was so contrary to that in vogue amongst chemists at that time that it challenged opposition, but time has vindicated its accuracy and importance. His researches on electric conductivity in gases have been almost equally fruitful, for they have served as the starting point from which other observers have advanced, and have thus led up to modifications of our ideas of the constitution of matter quite as profound as those suggested by the migrations of the ions.

PROF. ROBERT HENRY THURSTON.

By the death of Prof. Robert Henry Thurston, which occurred with tragic suddenness on his birthday, October 26, the United States has lost its most distinguished engineering professor, and a devoted educationist whom it will be difficult to replace.

He was born at Providence, Rhode Island, in 1839, and was the son of Robert L. Thurston, the founder of the Providence Steam Co. His early training was of that twofold character which has been so much discussed during the last year or two, a collegiate education at the Brown University, where he gradu-

ated C.E., Ph.B., in 1859, and a practical training during the same time in the workshops of his father's firm.

In 1861 he entered the United States Navy, serving from 1861–1865 first as assistant engineer and then as engineer in charge of vessels; this period covered the great Civil War, and the unique experience which Thurston then enjoyed no doubt did much towards turning his mind to experimental research, and probably altered the whole course of his life's work.

In 1865 he was appointed assistant professor of natural philosophy in the United States Naval Academy at Annapolis, and as his chief died a few weeks afterwards, Thurston had entire charge of the department until he resigned the post, in 1871, in order to take up the duties of professor of mechanical engineering in the Stevens Institute of Technology, an office he held until 1885.

It was while he held this chair that Thurston began to make his name known, not only in America, but in Europe; he was a prolific writer on technical subjects, and did much valuable research work in connection with the U.S. Board appointed to deal with the subject of testing metals, notably in the investigation of the properties of the various alloys of copper, tin, and zinc. During this period he also visited Europe as the U.S. Commissioner to the Vienna Exposition of 1873, and on his return published a valuable report.

In 1885 he took up the post which he held until his death, that of director of Sibley College; here he had full scope for his remarkable powers as a teacher and an organiser of scientific education of the most advanced character, and the most eloquent testimony to his success is the extraordinarily rapid growth in the number of students; from a mere handful in 1885, in eighteen years they have increased to nearly 1000, and Sibley College to-day stands in the very front rank of the great technical colleges of the world devoted to the scientific training of the men who are to be the leaders of the engineering profession in all its branches. Much of its success is due to the fact that he was from the first able to win the sympathy and support of the leading engineers of the States, with the result that the Sibley College graduates never find the least difficulty in securing paid posts as soon as they finish their college training.

Thurston altogether wrote some 20 volumes and more than 300 separate scientific papers; his fertility with the pen, when one considers the labours he daily went through as a teacher and director, is amazing, and some of his books bear traces of the haste and pressure under which they were produced.

Of his books, the most noteworthy are the following:—"Friction and Lost Work," "The Materials of Engineering," "A Manual of the Steam Engine," "Steam Boiler Construction," and "A History of the Steam Engine"; these are all in America recognised as standard works, and have found a ready sale also in this country. In fact, Thurston almost attained the same position as was held by Rankine for so many years in this country, and his books were consulted and used by thousands of young engineers scattered throughout the length and breadth of the great Republic.

Thurston was naturally the recipient of many honours; he was the first president of the American Society of Mechanical Engineers, holding office from 1880 to 1883, vice-president of the American Association for the Advancement of Science in 1877, 1878, and 1884, an LL.D. of the Brown University in 1889, &c.; he was twice married, in 1865 to Susan Taylor Gladding (she died in 1878) and in 1880 to Leonora Boughton.

Though Thurston devised several special forms of testing machines, he was not an inventive genius, and he did no work as a constructive engineer. It was as a writer and speaker that he made his influence felt, and how great that influence was will only be fully realised now that he has gone. T. H. B.

SIR FREDERICK BRAMWELL, F.R.S.

THE death of Sir Frederick Bramwell on Monday deprives engineering of one of its most energetic workers, and pure science of one who did much to promote its interests.

Sir Frederick Bramwell was born in London on March 7, 1818, and was apprenticed to one of the old school of mechanical engineers when he was sixteen years of age. After a varied experience he commenced practice on his own account as a civil engineer in 1853, and the following year became a member of the Institution of Mechanical Engineers. He was elected an associate of the Institution of Civil Engineers in 1856; and in 1862 attained full membership.

In 1874 Bramwell was chosen president of the Institution of Mechanical Engineers, and delivered an address in which he appealed to engineers to use to their utmost, and to use fairly, the natural resources at their command. As president of the Institution of Civil Engineers in 1884, he described in his address the chief factors of past progress, and advocated the treatment of large steel forgings by hydraulic pressure in place of steam hammers. He was president of the Mechanical Science Section of the British Association in 1872, and again at Montreal in 1884. He was elected president of the Association for the Bath meeting in 1888, when he delivered an address on the greatness of the works which the engineer creates out of minute beginnings.

Sir Frederick Bramwell received many marks of recognition from public bodies and learned societies. In 1873 he was elected a Fellow of the Royal Society. In 1881, the *Times* relates, he was appointed member of the Ordnance Committee, and in that capacity assisted in the framing of the rules under which iron and steel for the construction of large ordnance are tested before acceptance. After serving on the council and as a member of the board of management he was, on the retirement of Sir William Bowman in 1885, made honorary secretary of the Royal Institution. Always cordially lamenting the lack of facilities for technical education in his youth, he was a warm supporter of the movement for its advancement in this country. On the foundation of the City and Guilds of London Institute he was appointed by the Goldsmiths' Company one of its representatives on the governing body. A knighthood was conferred upon him in 1881, and a baronetcy in 1889. He received the honorary degree of D.C.L. from the Universities of Oxford and Durham, and that of LL.D. from Cambridge and McGill.

NOTES.

PROF. LUDWIG BOLTZMANN has been elected honorary member of the Moscow Academy of Sciences.

THE deaths are announced of Prof. Heinrich Moehl, director of the meteorological station at Cassel, at the age of seventy-one, and Dr. Nagel, formerly professor of geodesy in the technical high school at Dresden.

THE next meeting of the American Association for the Advancement of Science, and affiliated societies, will be held at St. Louis during convocation week beginning on

December 28, under the presidency of the Hon. Carroll D. Wright, U.S. Commissioner of Labour and president of Clark College.

THE Decimal Association has taken steps to introduce into the House of Lords early next session a Bill for the compulsory adoption of the metric weights and measures throughout the United Kingdom. The first reading of the Bill will be moved by Lord Belhaven and seconded by Lord Kelvin. If the measure passes the House of Lords, it will be brought before the Commons at the first possible moment, and it is hoped that a sufficient expression of public opinion will be forthcoming, at the time when the question is being debated, to convince the Government that they will do well to make it their own Bill.

WE have received a circular, the fifth, from the permanent committee of the International Congress of Botany, the second session of which is to be held at Vienna in 1905. At the Paris Congress, in 1900, the board of management on that occasion was constituted a permanent committee so that the congress might be in a position to communicate with the promoters of the Vienna meeting with a view to ensure complete success. The circular gives full information of the steps taken by the permanent Paris committee in the matter of botanical nomenclature, and describes the principles by which their discussions on this subject have been governed. All communications referring to the congress should be addressed to the general secretary, Dr. A. Zahlbruckner, Vienna, I., Burgring 7.

THURSDAY next, December 10, will be the 300th anniversary of the death of William Gilbert. In commemoration of this tercentenary the Mayor and other representatives of the Borough of Colchester will attend the meeting of the Institution of Electrical Engineers on Thursday next to receive a historical picture representing Dr. Gilbert in the act of showing his electrical experiments to Queen Elizabeth and her Court, which will then be presented by the Institution to the Borough of Colchester, where Gilbert was born in 1544, and died in 1603. At the conclusion of the presentation an ordinary general meeting will be held, at which a paper on the slow registration of rapid phenomena by strobographic methods: the "ondographe" and "puissancegraphe" (wave recorder and power recorder), will be read by M. E. Hospitalier, president of the Société Internationale des Électriciens. If time permit, a paper will also be read on the magnetic dispersion in induction motors, and its influence on the design of these machines, by Dr. Hans Behn-Eschenburg.

IN the *Journal de Physique* M. C. Maltézos discusses the sand ripples produced both by wind and water in connection with the theory that they represent the position of nodal lines produced by the interference of direct and reflected waves. This theory is supported by the author's observations made at Phalara (Attica), and a similar explanation is given of the agglomerations of pebbles which occur on many beaches. The phenomena are easily observed by anyone residing near the sea-shore, and an interesting feature is that ripples are formed in the sand even at depths of two or three metres.

PROF. A. RIGHI, in a paper read before the R. Accademia delle Scienze dell' Istituto di Bologna on May 24, describes experiments upon the electric charge generated by X-rays upon metals *in vacuo*. He begins by describing experiments confirming those of Curie and Sagnac, who proved that metals under the action of X-rays give off negative electrons or kathode rays, acquiring in consequence a positive charge which may become considerable if the pressure, and in consequence the ionisation, of the surrounding air be low enough. He next describes comparative measurements of the potential thus acquired under identical conditions by various substances. The last section treats of the variation of the potential acquired by the metal exposed to the X-rays, as its distance from the electrode facing it is varied.

IN the *Scientific Transactions* of the Royal Dublin Society, Mr. Arthur W. Conway, in a short note of four pages, discusses the fundamental equations of electrodynamics, and points out the difficulties attaching to existing theories when radiation is taken into account. The author proposes a system, consisting of a modification of Helmholtz's theory, which he considers is free from the objections attaching to Levi Civita's system. The equations assumed agree with the known relations for electrostatic phenomena, whilst for slow motions they reduce to those given by Helmholtz, which account for the phenomena of electric currents.

MR. J. MORROW publishes in the *Philosophical Magazine* some experiments on the determination of Poisson's ratio by means of a new instrument for measuring the lateral contractions of tie-bars. The instrument has two screws which touch the bar at the points between which the contraction is to be measured, and when the specimen is extended longitudinally the relative displacement of these screw-ends is determined optically. With this instrument values of Poisson's ratio were found for steel, cast iron, wrought iron, brass and copper, agreeing very well with Stromeyer's results.

DURING his exploration of Lake Aral in the years 1900 and 1901, M. L. N. Berg made the very interesting observation that this lake, which had been rapidly decreasing during the years 1850 to 1885, began slightly to increase in 1891. The level was raised during the years 1891 to 1901 by an average of 20 cm. every year. It appears now that during his exploration of Lake Balkhash, which he visited last summer, M. Berg found that this lake also, which was formerly drying up very rapidly, has begun lately to increase. On all sides poplar trees and bushes submerged to some extent are to be seen, while several peninsulæ, like Bai-kabyl, have become islands, and the road from Vyernyi to Karakol is now under water. The waters of the lake are extremely poor in animal life. The explorers found only two species of fishes—one of them the *Perca schrenckii*, special to this lake—while "the bottom of the lake is a real desert—no molluscs, not one worm." The plankton of the lake is, on the contrary, very rich in fresh-water forms. M. Berg found, moreover, to his great astonishment that the water of the lake in June last was quite fresh, along both the southern and the northern shores. As the Balkhash has no outflow, this fact is of special interest.

DR. A. E. WRIGHT AND CAPTAIN S. R. DOUGLAS show by a series of ingenious experiments that the fluids of the blood play an important *rôle* in connection with phagocytosis, the absorption and destruction of bacteria by certain of the white cells of the blood. By mixing bacteria with the white cells of the blood obtained by centrifuging and adding blood serum (*a*) unheated, *i.e.* in the natural condition, (*b*) heated to 60°–65° C. for ten to fifteen minutes, it is found that, under the same conditions, phagocytosis is much more active in the presence of the unheated than of the heated serum. The heating appears to destroy some

activating substance in the serum, the heated serum behaving as a simple diluent, like physiological salt solution (*Proc.* Roy. Soc. Lond., vol. lxxii. p. 357).

The October number of the *Emu* contains the photograph of a subadult Australian barn-owl in which large bunches of the nestling down are retained on the legs, thus communicating to the bird a most remarkable appearance.

The osteology and affinities of the kingfishers form the subject of an article in the October number of the *American Naturalist* by Dr. Shufeldt, who arrives at the conclusion that these birds are probably nearly related to the cuckoos, bee-eaters, and jacamars, although further investigations into the morphology and life-history of all these groups are necessary before these complicated relationships can be properly defined.

An interesting addition to the British marine fauna is recorded in the November issue of the *Zoologist*. Until 1899, when it was discovered on the coast of Brittany, the giant goby (*Gobius capito*), a fish attaining a length of 9 or 10 inches, was believed to be confined to the Mediterranean. As the result of a careful search of the rock-pools last summer, Mr. F. Pickard-Cambridge has demonstrated its comparative abundance on the Cornish coast. In the same journal Mr. P. Podmore describes and figures some fertile hybrids bred from the ring-dove (*Columba palumbus*).

The study of animals from the point of view of adaptation to their surroundings is now the fashion. The October number of the *American Naturalist* contains the first of a series of three or four articles written at the suggestion of Prof. H. F. Osborn on the adaptation of mammals to aquatic, arboreal, fossorial, and cursorial habits. Prof. Osborn states that a number of advanced students have undertaken the necessary investigations, and that the results are of great interest, and in some instances novel. The first of the series, by Mr. R. C. Osburn, deals with adaptations to an aquatic existence. It is pointed out that the extent to which this adaptation has been carried indicates the relative date at which an aquatic or semi-aquatic life was commenced. Most aquatic mammals have depressed and expanded tails, but in the musk-rat and Potamogale this organ is compressed. The latter animal, at any rate, swims, like a newt, by the aid of its tail, to which the hind-limbs are closely pressed; consequently there is no need for webbed feet. Kükenthal's theory that the increased number of phalanges in the flippers of cetaceans is due to the development of double epiphyses, one of which forms an additional phalange, is considered to be probably true. The fact that toothed cetaceans display indications of descent from an armoured ancestor, while the whalebone whales probably trace their descent from a fully haired form, seems to support the diphyletic origin of the two groups.

Pamphlet series No. 25, issued by the Imperial Department of Agriculture for the West Indies, contains a paper on ground nuts in the West Indies, by Mr. W. G. Freeman, until recently the scientific assistant to the Department. Hitherto, although ground nuts are easily grown in the islands, no attempt has been made to cultivate them on a sufficiently extensive scale to supply even local requirements, and quantities have consequently had to be imported. A summary of the results of the experiments on the cultivation of seedling and other canes at the experimental stations at Barbados, 1903, is given in No. 26 of the same series of publications. There were twenty-two fields of canes under experimental cultivation on nine estates situated in typical localities, the canes in each case being treated in exactly the same manner as the other canes on the estate. The best all-round cane proved to be the Barbados seedling, B 208, the second place being taken by B 147, the average quality of its juice being fair.

The reintroduction of cotton growing into the West Indian Islands has soon been followed by the appearance of a destructive pest, the cotton worm or caterpillar—*Aletia argillacea*—which is causing considerable anxiety, as it strips a whole field in a single night. It is affecting Barbados, Montserrat, Antigua, and St. Kitt's-Nevis. The officials of the Agricultural Department are actively engaged in devising methods for efficiently coping with the evil.

Dr. A. Freiherr von Bistram has reprinted from the *Berichte* der naturforschenden Gesellschaft zu Freiburg im Breisgau his paper on the dolomite region of Lugano. It is accompanied by an excellent coloured geological map on the scale of 1 : 50,000, and the author has occasion to praise the contoured maps of the Italian Government, which, on this large scale, and with well-marked footpaths, have proved of service to so many geologists. The most striking feature of the district is the great east-and-west fault dividing the Triassic beds from the crystalline rocks on the north. The dolomite is thickened locally by repetition through earth-movements, after the fashion made familiar to us by the work of Dr. Ogilvie-Gordon and others, but the similarity of the strata prevents adequate mapping of the details. The style of the author enables one clearly to realise the landscapes, as in his picturesque description of the Val Solda. The obliquity of the axis of the Lake of Lugano to the structural folding of the district leads him to assign to it a glacial origin. The author lays stress on the primary differences in the strata deposited in neighbouring areas, as affecting the manner of their subsequent deformation. His notes on the sections actually visible make the paper especially useful to subsequent visitors, and some of his criticisms affect the published maps of the Swiss Geological Survey.

The *Scientific American*, in its issue for November 14, publishes a very complete and excellently illustrated account of modern printing methods, machines and appliances.

Messrs. Macmillan and Co., Ltd., have issued part iv. of "A School Geometry," by Messrs. Hall and Stevens. The booklet runs to twenty-eight pages, and contains the substance of Euclid Book ii., together with Book iii., Props. 35–37. Its price is 6*d*.

Messrs. Longmans, Green and Co. have just published a small work on "The Analytical Chemistry of Uranium," by Mr. H. Brearley, which contains a mass of information relative to the determination of the metal in its ores and in commercial products. The material is divided into four chapters, dealing respectively with the modes of estimating uranium, the estimation of uranium as phosphate, the separation of uranium, and the analysis of uranium ores.

Messrs. Charles Griffin and Co., Ltd., have published the twentieth annual issue of the "Year-book of the Scientific and Learned Societies of Great Britain and Ireland." The publication forms a record of the work done in science, literature and art during the session 1902–1903 by a large number of societies and Government institutions. The information has been compiled from official sources, and should consequently be quite trustworthy. We notice that no details of the Geographical Association are given, or of the Association of Science Masters in Public Schools.

The determination of vapour densities at high temperatures by application of the diffusion method of Bunsen is discussed in a paper by Prof. Emich communicated to the Vienna Academy. For one and the same gas at different temperatures the time of diffusion of a given volume should be proportional to the square root of the absolute temperature. Experiments with tubes of porcelain, platinum, and iridium show that this requirement is approximately fulfilled, and investigations on diffusion are now being carried out up to a temperature of 2000° C.

According to Mr. W. Ackroyd, colour changes are frequently brought about by the action of radium rays. These changes have been examined by embedding a radium bromide tube in the substance experimented upon. After a few hours sodium chloride becomes orange or buff coloured, potassium chloride becomes violet but returns to its original colour very quickly after removal of the exciting cause. Sodium bicarbonate and potassium metabisulphite are changed to amethyst colour after twenty-four hours' exposure.

We have received the second number of vol. i. of the *Journal de Chimie physique*, published under the direction of Prof. Guye, of Geneva. The number contains two interesting papers, one by Prof. Duhem on the eutectic and transition points of binary mixtures which give rise to mixed crystals, the other by Prof. Guye on the electrolysis of alkaline chlorides. The reviews of current physicochemical literature which form the second part of the publication are exceedingly well written, and the papers reviewed are, moreover, of quite recent publication, a statement which cannot be made of many abstracts in other physicochemical journals.

In the November issue of the *Moniteur Scientifique* M. Combes discusses the various attempts which have been made to obtain the diamond artificially. Against the common supposition that the diamond can only be produced at high temperatures, the author cites several observations which seem to indicate that natural diamonds, at any rate, cannot have been formed under such conditions. The hypothesis that high pressures are necessary for the artificial production of diamonds is not in accord with actual experimental facts, and the author arrives at the conclusion that in the experiments of Moissan the pressure plays no essential part, and that the optical properties and the analysis of the crystals obtained by this chemist do not warrant the conclusion that these are to be regarded as diamonds.

The additions to the Zoological Society's Gardens during the past week include a Bonelli's Eagle (*Nisaëtus fasciatus*), European, presented by Mr. G. H. Baxter; a Matamata Terrapin (*Chelys fimbriata*) from Guiana, presented by Mr. E. Bieber; a Yellow-fronted Amazon (*Chrysotis ochrocephala*) from Guiana, a Lesser Sulphur-crested Cockatoo (*Cacatua sulphurea*) from Moluccas, a Common Buzzard (*Buteo vulgaris*), European, deposited; an Ourang-outang (*Simia satyrus*) from Borneo, purchased.

OUR ASTRONOMICAL COLUMN.

Astronomical Occurrences in December:—

Dec. 3. 6h. 44m. Minimum of Algol (β Persei).
6. 17h. 40m. to 18h. 41m. Moon occults λ Geminorum (Mag. 3 6).
11. Predicted perihelion passage of Brooks's periodical comet (1889 V–1896 VI).
11–13. Epoch of Geminid Meteors (Radiant 108° + 33°).
14. 12h. Venus in conjunction with the Moon. Venus 0° 5′ S.
15. Venus. Illuminated portion of disc = 0·586.
16. 3h. 7m. to 6h. 26m. Transit of Jupiter's Sat. III.
20. 12h. Mars and Saturn in conjunction (Mars 0° 33′ S.).
22. 12h. Sun enters Capricornus. Winter commences
23. 7h. 17m. to 10h. 36m Transit of Jupiter's Sat. III.
,, 8h. 27m. Minimum of Algol (β Persei).
25. 6h. 0m. Jupiter in conjunction with the moon (Jupiter 2° 40′ S.).
26. 5h. 16m. Minimum of Algol (β Persei).
,, 23h. 0m. Neptune in opposition to the sun.
31. 12h. 50m. Near approach of moon to Aldebaran (α Tauri).
,, 18h. 0m. Mercury at greatest elongation (19° 30′ E.)

Determination of Standard Stellar Velocities.—In accordance with the cooperative scheme for regularly determining the velocities of certain standard stars, Profs. Frost and Adams have, during the past twelve months, made independent observations of the radial velocities of thirteen stars, the results of which are given herewith:—

Star	Mean velocity in kilometres per sec.
α Arietis	−13·7
α Persei	− 2·1
β Leporis	−12·4
β Geminorum	+ 3·4
α Crateris	+47·4
α Böotis	− 4·8
θ Ophiuchi	−11·1
γ Aquilæ	− 1·8
γ Cephei	−41·2
ϵ Pegasi	+ 6·2
γ Piscium	−10·9
ι Aurigæ	+19·0
ϵ Leonis	+ 5 5

The Bruce spectrograph of the Yerkes Observatory, with various cameras attached, has been used, and, in the majority of cases, the spark spectrum of titanium has been employed to give the standard comparison wave-lengths. Three photographs of each star have been obtained, except in the case of β Leporis, where the low altitude and poor observing conditions have prevented more than one being taken. A range of 1·8 km. in the determined velocities of ϵ Leonis indicates the existence of a real variation, but more photographs must be measured before the point can be decided. An unaccountable difference of −0·5 km. is shown between the velocity of Arcturus as determined from eight earlier plates and that obtained from the five plates recently obtained, unaccountable because in the spectrum of this star the lines are so well defined (*Astrophysical Journal*, vol. xviii., No. 4).

New Elements for η Aquilæ.—From 352 observations of the magnitude of η Aquilæ, made at the Lyons Observatory between June 3, 1898, and December 22, 1902, M. M. Luizet obtained the times of fifty-five maxima and fifty-three minima, and, on comparing them with those calculated from the elements obtained by Schür, and published in "Chandler's Third Catalogue," he found that a difference amounting, in the mean, to +0·2 day existed, and therefore thought it advisable to compute a new set of elements. This he did by employing the maxima and minima data used by Schür, and combining with them the results obtained from his own observations; the result showed that it was necessary to apply a correction of 0·106 ± 0·021 day to the original epoch of maxima, and 0·0166 ± 0·035 day to that of minima, and, in each case, a slight correction to the length of the period.

Applying these corrections to the data used by Schür, one obtains for the original epochs

Maxima 2396168·738 days,
Minima 2396166·365 days,

and for the length of the period

7·176382 days.

The new elements, based on these data, are as follows :—

$$\begin{array}{ll} \text{Maximum} = \text{J.D. } 2396 \;\; 168{\cdot}738 \\ \text{Minimum} = \text{J.D.} \qquad\;\; 166{\cdot}365 \end{array}\Bigg\} \begin{array}{l} (\text{M.T. Paris}) + 7{\cdot}176382 \text{ E.} \\ + 0{\cdot}14 \sin (0^{\circ}{\cdot}044 \text{ E.} + 304^{\circ}) \end{array}$$

or

$$\begin{array}{ll} & \text{d. h. m. s.} \\ \text{Maximum } 1848 \text{ May} & 20\ 17\ 42\ 43 \\ \text{Minimum} \quad ,, \quad ,, & 18\ \ 8\ 45\ 36 \end{array}\Bigg\} \begin{array}{l} \text{d. h. m. s.} \\ + 7\ 4\ 13\ 59{\cdot}4 \text{ E.} \\ + 202\text{m.} \sin (0^{\circ}{\cdot}044 \text{ E.} + 304^{\circ}) \end{array}$$

and a comparison of the weighted means of his own and other observations leads M. Luizet to the conclusion that the interval between the principal and secondary maxima is 2·373 days, or 2d. 8h. 58m. (*Astronomische Nachrichten*, No. 3911).

ABSORPTION OF STAR LIGHT BY COMET 1903 *c*.—Prof. Max Wolf publishes, in No. 3914 of the *Astronomische Nachrichten*, two photographs of comet 1903 *c* taken on July 25 when the comet was passing in front of the 6·5 magnitude star B.D.+63°.1056. On comparing these photographs with the observations of comet 1902 III., Prof. Wolf arrives at the conclusion that the later comet exhibited a selective absorption of star light which was not exhibited by the earlier one.

PUBLICATIONS OF THE PULKOWA OBSERVATORY.—Vol. x. (2nd series) of the *Publications* de l'Observatoire Central Nicolas, edited by M. M. Nyrén, contains the details of the observations made with the prime-vertical transit instrument from 1869 to 1896. In the introduction, M. Nyrén discusses very minutely the errors of the instrument and their corrections, paying particular attention to the causes which might produce a small yet persistent residual as yet unaccounted for.

The results were analysed in order to test the validity of Chandler's "$\Delta\phi$" term for the variation of latitude, and they indicate that that observer's empirical formula requires some slight modification, although M. Nyrén hesitates to make a definite statement on this point. The constant of aberration as deduced from these observations is 20″·4423 if Chandler's term be considered; without the latter the value is 20″·4451, and M. Nyrén observes that, in the mean, this term seems of small importance.

In vol. xiii. of the same *Publications* M. Nyrén publishes a new catalogue of 1336 reference stars situated between dec. −30° and dec. +90°. This differs from Struve's Pulkowa catalogue in only containing stars between magnitudes 5 and 7; at least this was the original proposal, but it has been found necessary in practice to admit others which are just outside these limits. The idea of this selection was to include stars which were faint enough to give exact readings, and not too faint to be observed with the vertical circle used. Another feature of the catalogue is the division of the zone into squares, of which each side is 5° in length, and the observation of only one star in each zone, thus ensuring the even distribution of the reference positions without incurring too great a labour in the observations. The section of the zone −15° to +90° was observed at Pulkowa, and stars selected from the Bonn Durchmusterung were used, whilst the remaining section was observed at the subsidiary observatory at Odessa, where the Cordoba catalogue was used. Details of each observation made are given in the catalogue, and, together with the results, they occupy 487 quarto pages.

GUIDE FOR ASTRONOMICAL AND GEODETICAL CALCULATIONS.—Part ii. of Signor J. Boccardi's "Guide du Calculateur" will be found to be an extremely useful reference book by all who desire to perform calculations of observational results in astronomy or geodesy. It gives lucid explanations of many typical computations, such as the calculation of precessional effects, reductions to apparent place, elements of orbits, the determination of an orbit from three observations, and the special perturbations of an orbit; it also explains and illustrates the method of "least squares." Under the heading of "Geodesy" the solutions of many typical problems are explained and examples worked out, several special methods being named and clearly elucidated. Numerous worked examples are given throughout the book, each problem and method being clearly illustrated in this manner. The work is published by M. A. Hermann, 6 Rue de la Sorbonne, Paris.

THE EDISON ACCUMULATOR.[1]

MR. W. HIBBERT read a most interesting paper on the Edison accumulator before the Institution of Electrical Engineers last week. Since the first announcement of Mr. Edison's invention nearly three years ago, very little of an authoritative nature has been published about the cell; the paper which Dr. Kennelly read in May, 1901, showed that the invention was full of promise, and further results of more extensive experiments and of practical trials have since been awaited with eagerness. A description of the cell itself was published in NATURE in July, 1901 (vol. lxiv. p. 241), and as it has undergone little alteration since then we need not describe it in detail here; the active materials, it will be remembered, are nickel oxide and iron, and the electrolyte is a 20 per cent. solution of caustic potash; the chemical changes on charge and discharge may be represented by the equation

$$\overset{\text{After charge}}{NiO_2 | KHOaq | Fe} \rightleftarrows \overset{\text{After discharge}}{NiO | KHO.aq | FeO,}$$

the electrolyte serving merely as an oxygen carrier, and not taking any actual part in the final changes of the active material, as does the sulphuric acid in the lead-lead-peroxide cell. The active materials are packed in perforated steel pockets, and the plates, though thin, are rigid and light. The construction is thoroughly mechanical throughout, and the lightness is obtained without any sacrifice of durability,

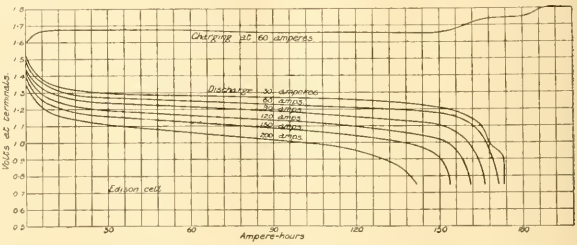


FIG. 1.—Discharge Curves of Edison Cell. From the *Journal* of the Institution of Electrical Engineers.

which is one of the chief faults of the lighter types of lead cells. The standard size of automobile cell is 13 inches high (over all) and 5·1×3·5 inches horizontally. The weight is 17·8 lb. The E.M.F. is approximately 1·35 volts, and the internal resistance 0·0013 ohm; the output at 60 amperes discharge is 210 watt-hours, the capacity working out, therefore, at 11·8 watt-hours per lb. This figure agrees very closely with those which were published originally; Dr. Kennelly put the output at about 14 watt-hours per lb., and, in the article referred to above, we calculated from a discharge curve which had been published an output of 10 watt-hours per lb. The lightest lead cells in some instances approach, or even exceed, these figures, but on the average the result is considerably better than that obtainable in practice with lead accumulators. It will be seen, however, that in many other respects the Edison cell promises to prove much superior, especially for motor-car work.

Mr. Hibbert's tests were made partly under laboratory conditions and partly on the road. The discharge curves reproduced in Fig. 1 were taken in the laboratory, and show that the Edison cell possesses in a remarkable degree one very desirable characteristic, namely, that of giving a good output in ampere-hours when discharged at heavy discharge rates. Taking the normal discharge current as 30 or 40

[1] "The Edison Accumulator for Automobiles." By W. Hibbert, Abstract of paper read before the Institution of Electrical Engineers. November 26.

amperes, the curves show that more than 80 per cent. of the normal ampere-hours can be obtained when discharging at so high a current even as 200 amperes. A lead cell under similar conditions would probably not give more than 50 per cent. of its normal output. Experiments on the road showed that this result could be obtained under practical conditions. A 32 mile run was made from Leicester to Northampton against a head wind all the way; on the level the current varied from 55 to 60 amperes, as against the usual 40; uphill it was from 90 to 100 amperes, and on one occasion rose above 150 amperes. The total discharge came out as 190 ampere-hours, the normal standing discharge being 160 ampere-hours. The battery had been fully charged before the start, 242 ampere-hours having been put in in 1 hour and 20 minutes. This particular case shows that there is an extra discharge—30 ampere-hours in this instance—which can be got from the cell; it is due to the fact that the voltage at the end of the discharge does not continue to drop rapidly as shown in the curves in Fig. 1, but, when it has fallen to about half a volt, becomes steady again for another hour. There is, in consequence, a reserve of capacity which, though not generally used, may prove very valuable in emergencies such as the above.

Some other results obtained by Mr. Hibbert may be quoted. A cell after being short circuited for 48 hours recovered its original capacity after two charges, and was apparently none the worse for this severe treatment. Experiments on the rate of charging were tried, and showed that high charging currents can be safely used. A fully discharged cell was recharged for an hour at 177 amperes; 124 ampere-hours, or 70 per cent. of the charge, were obtained on discharge at 60 amperes. Experiments on the road confirmed this result, 70 per cent. of the charge being obtained after charging at 200 amperes. The efficiency of the cell is not quite so good as that of a lead cell; the following figures were obtained under different conditions:—at 30 amperes charge and discharge 66 per cent., at 60 amperes 60 per cent., at 100 amperes charge and 60 amperes discharge 56 per cent., and at 177 amperes charge and 60 amperes discharge about 50 per cent. On the other hand, the cell endures a period of rest before discharge well, and also does not suffer if allowed to stand discharged for some time. If discharged immediately after charge a somewhat large discharge is obtained, but after two days' rest a discharge of 155 ampere hours is given; a further twenty-four days' rest only had the effect of diminishing the discharge to 125 ampere hours, or 80 per cent. of the discharge after the two days' rest.

The trials on the road were made in a runabout with a battery of 38 cells, weighing about 700 lb.; the total weight, with two persons, was about 2000 lb. The trials were planned to afford answers to the following questions:—

(1) Is the capacity the same on the road as in the laboratory?

(2) Will the battery stand excessive discharges on the road?

(3) Will it take a rapid charge and utilise it on the road?

(4) Will it recover after lying discharged for some time?

(5) Does the capacity fall off by reason of the shaking?

(6) What attention is required?

The experiments which we have already quoted show that the answer to the first four questions is in the affirmative. With regard to the fifth question, the results were very satisfactory. The car had run 400 miles before Mr. Hibbert took it over; its capacity was then 159 ampere-hours on standing discharge. Mr. Hibbert ran it in all 500 miles in the course of a month, and at the end of that time the capacity on standing discharge was 158 ampere-hours, showing, therefore, no appreciable deterioration. As regards attention, Mr. Hibbert found very little to be required; none of the terminals worked loose or showed signs of getting unduly warm with the heavy charging currents sometimes used. The only matter that had to be attended to was the replenishing with distilled water which was required after every five or six charges.

The general results of Mr. Hibbert's tests are most encouraging; the only point on which further information is required is durability, but all the evidence is in favour of this proving satisfactory. It certainly seems as if the hopes aroused by Dr. Kennelly's paper are within measurable distance of realisation.

M. S.

THE UNITED STATES GEOLOGICAL SURVEY.

We have received parts i. to iv. of the twenty-second annual report of this survey for 1900–1. In part i., after the administrative report by Mr. C. D. Walcott, the director, there is an elaborate essay on the asphalt and bituminous rock deposits of the United States. The author, Mr. G. H. Eldridge, points out that while sandstones are storage reservoirs for mineral oils or bituminous deposits, limestones may be the place of origin as well as the means of storage. Ozocerite has been formed in some strata by the draining of petroleum pools or of strata richly saturated in oil. The author instances a reservoir in California that rests on granite, and has been filled from overlying deposits.

In part ii. ore deposits are dealt with. There is an account of the tungsten mine at Trumbull, Conn., and it is mentioned that wolframite is produced by alteration of scheelite through replacement of its calcium by iron and manganese. The ore deposits of Rico Mountains comprise galena, often argentiferous, sphalerite or zinc blende, chalcopyrite and magnetite; those of the Elkhorn district include argentiferous galena and gold, and the metalliferous deposits are believed to have been derived from igneous rocks (gabbro) lying beneath limestones, through the agency of uprising hot siliceous waters. The Blue Mountains of eastern Oregon comprise, near Baker City, an important gold-field. The mountains consist of cores of older rocks with Tertiary rhyolites, andesites, and basalts. Gold and silver occur in veins in the older rocks, and gold occurs also in placer deposits. In Monte Cristo, Washington, there are ores of copper, lead, zinc and arsenic. The lead and zinc mines of the Ozark region are dealt with in considerable detail, with respect to the relation and to the concentration of the ores, whether by ascending or descending waters. The original precipitation of the metals is traced back to the agency of organic matter, aided by concentration and evaporation in shallow seas, such as characterised the dolomitic beds of Cambro-Silurian age. Analyses show minute, but important, amounts of zinc and lead in the pre-Cambrian, Cambro-Silurian and Carboniferous rocks. The workable ores have been deposited in the fractured and brecciated areas of Carboniferous Limestone. The author discusses the chemical processes which have led to the deposition of these ores; these have in succession been oxidation of sulphides, transportation as sulphates, and precipitation in the crevices of the rocks as sulphides. Some of the ores have since been superficially changed to carbonates.

Part iii. deals with coal, oil and cement. There are statistics relating to the coal-fields of the United States, particulars about the anthracite coal-field of Pennsylvania, with its disturbed, vertical and overturned coal, and descriptions of various other coal-fields, and of the Gaines oil-field of Pennsylvania. Accounts are given of the Portland cement industry in Michigan, and of the manufacture of hydraulic cement in south-west Arkansas, where chalk comparable with that of England is used.

Part iv. deals with hydrography, with stream measurements, the hydrography of the American isthmus, and of the high plains.

We have received also part i. of the twenty-third annual report for 1901–2. It contains the report of the director, Mr. C. D. Walcott, who describes the methods of work, and appends a memoir, with portrait, of the late Clarence King.

In addition we have received a preliminary report on the Ketchikan mining district of Alaska, by Mr. Alfred H. Brooks, who deals with the gold-bearing properties and with certain silver and lead deposits; and a reconnaissance of the north-western portion of Seward Peninsula, in Alaska, by Mr. A. J. Collier, with reference to the more important gold-fields. These reports, which are naturally somewhat sketchy, will be of service to those who contemplate mining enterprises in the districts.

Two monographs of the Geological Survey have recently been published. Monograph No. xlii. is on "The Carboniferous Ammonoids of America," by Mr. James Perrin Smith. The writer tells us that he makes "no distinction between goniatites and ammonites, because there is none that will hold." He remarks that while nearly all the characteristic

European genera are present in America, some are extremely rare, represented by a single species; others have a different range in America from that in Europe. These differences of range and association give hints as to the region where some of the forms originated, but the information is too indefinite to allow any positive statements as to the faunal geography of that time. The author, however, concludes that at least periodically there was easy intermigration between the American and the European waters, for the community of genera, and even of species, is too great to be explained by any other hypothesis. We note that *Glyphioceras calyx, Goniatites crenistria, G. sphaericus* and *G. striatus* are recorded from the Lower Carboniferous of America. The work is illustrated by twenty-nine plates.

Monograph No. xliii. is on "The Mesabi Iron-bearing District of Minnesota," by Mr. Charles K. Leith. The iron-bearing formation occurs in the Upper Huronian, and in what is known as the Biwabik division. This comprises a variety of rocks, including slates, cherts, and "greenalite." This last-named substance consists largely of minute granules of green ferrous silicate, without potash, and is named greenalite for convenience. The cherts and iron ores are shown to develop mainly from the alteration of the greenalite granules. Interbedded slate-rocks occur, and paint-rocks have resulted from their alteration. The iron ores are in basin-shaped deposits of considerable horizontal extension. Full particulars are given of these and of the methods of mining, while other rocks which enter into the structure of the district, the Archæan, Lower Huronian, the Keweenawan gabbro, the Cretaceous rocks, and Glacial drifts are described. The work is accompanied by maps, pictorial views, and plates of microscopic sections.

A series of *Bulletins* of the Geological Survey (published 1902–3) has been received. No. 203 comprises the invaluable "Bibliography and Index of North American Geology for 1901," by Mr. F. B. Weeks; 866 works are listed, and they are for the most part accompanied by brief notes of the contents. In No. 191, also the work of Mr. Weeks, there is a list and references to "North American Geologic Formation Names," a work of unquestioned utility. We cannot help thinking that formational terms should, wherever possible, be derived from original place names. Even names like the Appotomax, Bearwallow, Caloosahatchie, Shawangunk or Wapsipinicon beds are preferable to those of Alnwick, Barnstaple, Falmouth, Tisbury and Tiverton beds, some of which have a meaning in this country. Other native names, such as the Anamosa, Keewatin, Shenandoah and Wyoming, and even the Mormon beds, are appropriate.

No. 206 is a study of the fauna of the Hamilton (Devonian) formation of the Cayuga Lake section in Central New York, by Mr. H. F. Cleland. An attempt was made to collect the complete "faunule" from each zone, and it is stated that the examination failed (with one possible exception) to reveal any evolutional changes. The species are as distinct or as variable in one portion of the section as in another. Apparently it makes little difference how much time elapses so long as the conditions of environment remain unchanged. Some repetition of faunas is noted.

In No. 205 Mr. G. B. Shattuck deals with the Mollusca of the Buda (Cretaceous) Limestone, and Mr. T. W. Vaughan deals with the corals. The work is accompanied by many plates of fossils. In No. 204 the fossil flora of the John Day Basin, Oregon, is described and illustrated by Mr. F. H. Knowlton. The beds which yield the plants are Eocene and Miocene.

In No. 195 Mr. T. N. Dale contributes a second paper on structural details in the Green Mountain region and in eastern New York. Various structures in pre-Cambrian and Cambrian rocks, showing the complex interaction of mechanical and chemical processes, are described, and in one case the amount of shear is indicated by deflected annelid borings.

Economic geology receives treatment in several *Bulletins*. No. 199, by Mr. I. C. Russell, is on the geology and water resources of the Snake River plains of Idaho. Many curious volcanic features are illustrated, including some volcanic bombs. No. 198 is on oil sand in Ohio; No. 200, on borax deposits in California, and No. 202 on gold and silver in western Kansas. In No. 207 there is an essay on the action of ammonium chloride upon silicates.

Geography is illustrated in No. 196, wherein Mr. J. S. Diller treats of the topographic development of the Klamath Mountains in California and Oregon; in No. 197, by Mr. H. Gannett, on the origin of some ten thousand place names in the United States; and in No. 201, which contains results of primary triangulation.

The Maryland Geological Survey, under the direction of Prof. W. B. Clark, sends two memoirs on the counties of Cecil and Garrett. These deal exhaustively with the local geology and topography, with the rocks igneous and stratified, the mineral resources, soils, climate, forests, &c. They are well illustrated and admirably printed, and with their colour-printed maps they may be regarded as in all respects models of what geological survey memoirs should be.

H. B. W.

WINTER WHITENING OF ANIMALS.[1]

THE winter whitening of animals, though of intense interest to zoologists, is very imperfectly understood. Most writers are satisfied to believe that this colour change was perfected somehow under the action of natural selection for the protective purposes of adaptation to environment. Its origin they leave as an unsolved problem.

I find, however, that the change has a deep physiological significance. There is, for instance, in mammals a definite sequence in which the various parts of the body whiten. This sequence corresponds to the summer accumulation of fat in the panniculus adiposus. Thus the belly, where peripheral fat is thickest, is permanently white, and the rump, where also fat accumulates thickly, is usually the first part to whiten in winter.

Many northern mammals and birds not usually regarded as of the winter-whitening category are lighter in winter than in summer. The whiteness or white patches assumed in the former season correspond to the fat tracts, so that these species may be regarded as subject to the same process.

In the northern summer most animals accumulate fat, always in a definite manner as regards the regions where it is deposited. This fat is indicative of deficient oxydisation and of sluggish metabolism, and the process of its accumulation is therefore one of atrophy. The fat accumulation and atrophy are most marked in autumn, at which season metabolism is therefore lowest. With the onset of winter cold, the atrophy may extend to the hairs. Their pigment (as observed by Metchnikoff) is then removed, always, however, commencing with those parts where peripheral fat is thickest, and atrophy therefore greatest. Should there be a change of coat at this time, the new hairs are influenced by the same conditions. In very cold countries they come up white all over the animal; in more temperate regions the parts only where fat is thickest are white.

Although a pigmented hair can thus undergo atrophy and loss of pigment, I know of no case where the colour is replaced. Animals once whitened remain so until the spring moult.

These facts apply broadly to birds and mammals, but the hare and stoat are the species which I have studied especially.

Similar laws govern a great deal of the distribution of the white colour throughout the vertebrate phylum, wherein the connection between white colour and the peripheral fat tracts (thus indicating local atrophy) may be widely traced. Thus domestic animals, nearly all of which are prized most for their power of accumulating fat, exhibit a strong tendency to the development of white patches. In both these and in wild animals the belly, where occurs the principal fat tract, is the most frequently white part; next follow the rump, and parts of the neck, of the limbs and of the head.

Marked exceptions are, no doubt, frequently due to unusual arrangements of the panniculus adiposus. Thus in the badger, a representative of a family in which the back is usually whiter than the belly, I find a correspondingly exceptional arrangement of the fat tracts.

[1] Abstract of a paper read before the Royal Irish Academy on May 11 by Capt. Barrett Hamilton, on a physiological theory to explain the winter whitening of birds and mammals living in snowy countries, and the most striking points in the distribution of white in vertebrates generally.

The white of the head—the "blaze" of horses, the facial stripes of the badger—often affects regions not of fat accumulation, but where the skin immediately overlies bone and membrane (frontals and nasals and zygomatic arch), which thus seem to produce an atrophy similar to that caused by underlying fat.

In many animals the hair-atrophy assumes the form not of whitening, but of baldness. Marine mammals are hairless in proportion to the development of their peripheral fat-layer; fattening cattle lose their hair, while the baldness of man corresponds in position to the "blaze" of horses, and the bare buttocks of monkeys to the white rumps of other animals.

Yellow and red frequently follow the same rules of distribution as white. They are well known to be fat pigments.

I must carefully guard myself against the extension of my theory to all cases where white occurs in vertebrates. It is obvious that not all animals are subject to this atrophy, and that there must be other causes for absence of pigment. It seems highly probable from what I have written that the known unevenness of animal coloration is but the external indication of uneven nutrition in different regions of the body.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—Prof. J. A. Ewing, F.R.S., and Prof. Karl Pearson, F.R.S., have been elected honorary fellows of King's College.

Mr. W. Chawner, Master of Emmanuel, has been appointed an elector to the Sadlerian professorship of mathematics, in succession to the late Dr. N. M. Ferrers.

Mr. C. H. Talbot has presented to the university a number of instruments used for the researches of his father, Mr. H. Fox Talbot, F.R.S.

The Duke of Bedford has presented to the Museum of Zoology a number of valuable specimens of *Cervus davidianas*.

Mr. W. Bateson, F.R.S., and Mr. A. C. Seward, F.R.S., have been appointed members of the botanic garden syndicate; Prof. Marsh a member of the museums syndicate; Mr. W. M. Coates and Mr. E. T. Whittaker members of the observatory syndicate; Dr. D. MacAlister and Prof. Marsh members of the State medicine syndicate; Dr. J. Griffiths a member of the medical board; Mr. F. H. Neville, F.R.S., a member of the board for physics and chemistry; Mr. J. E. Marr, F.R.S., a member of the board for biology and geology; Mr. A. C. Seward, F.R.S., a member of the board for agricultural studies; Mr. F. C. Parsons an examiner in human anatomy.

The grace for the appointment of a syndicate to consider changes in the university studies and examinations was carried by 170 votes *placet* against 79 *non-placet*. The members of the syndicate as proposed were appointed by 156 votes to 92.

IT is reported that the late Mr. Seale Hayne has left residue estate amounting to more than 100,000*l*. for the purpose of establishing a college of science, art, and literature in Devonshire.

UNDER the auspices of several Greek educational societies recognised by the State, an educational congress will be held in April, 1904, in Athens. In connection with the congress it is intended to organise an exhibition of educational books and apparatus which will include an international section. Foreign contributors should deliver their exhibits in Athens not later than February 14, 1904. Detailed information can be obtained from the secretary, M. G. Drossinis, Comité d'Organisation du Congrès hellénique d'Éducation, Bureaux du Syllogue pour la Propagation de Livres utiles, 42 Rue de l'Académie, Athens.

A COMMUNICATION from the Privy Council has been received by the agents for the promotion of the proposed University of Yorkshire with reference to the application for a charter for the Yorkshire College at Leeds. The Lords of the Committee of Council state that, in view of the additional information as to their financial position and prospects which the promoters of the Yorkshire College petition are able to furnish, they agree to recommend the grant of a charter following generally the terms of the draft submitted, on the understanding that the West Riding County Council makes a substantial subvention towards the maintenance of the university, and that the promoters undertake to raise a capital sum of at least 100,000*l*. by the earliest possible date. As to the title of the university, it is pointed out that "The Victoria University of Yorkshire" implies a possessory interest in the whole of Yorkshire, and objection might be made to it. Also, the use of the name "Victoria" might cause confusion with the "Victoria University of Manchester."

THE report on the work of the department of technology of the City and Guilds of London Institute for the session 1902–3 shows a marked increase in the number of examinees from India and the colonies. Last year India sent up 29 candidates and the colonies 148. This year 53 Indian and 238 colonial candidates were presented for examination, 51 from New South Wales and 167 from New Zealand. Applications have been received from Cape Colony for the holding of examinations in telegraphy and telephony, manual training and other subjects, and the Agent-General has undertaken to transmit the question papers to the colonial educational authorities and to afford all necessary facilities for the conduct of the examinations. The number of candidates in cotton spinning examined in India is steadily increasing. In mechanical engineering there is also a large increase. There has been also a continuous and uninterrupted increase in the total number of classes registered by the Institute for instruction and in the number of students in attendance. While in 1902 the number of centres was 364 with 2320 classes and 36,189 students in attendance, in 1903 there were 396 centres, 2789 classes, and 38,638 students.

AT the annual dinner of the Institution of Mining and Metallurgy last week, Sir W. Anson, Parliamentary Secretary to the Board of Education, in proposing the toast of "The Institution," referred to the scheme for a great school of technology in London, and promised the cordial and hearty cooperation of the Board of Education. Some months ago, he continued, the Board had in view the appointment of a committee to inquire into the Royal College of Science and Royal School of Mines in their special relation to this scheme. He thought he could safely say that that committee, of which Sir F. Mowatt had consented to become the chairman, would be appointed, and would commence work in January next. He was glad to be able to assure them of the cordial cooperation of the Board of Education in any scheme for the advancement of practical scientific education. He welcomed the efforts of the Institution of Mining and Metallurgy to advance technological study, because it was of immense importance to the education of the country that they should find among men of business this appreciation of the value of knowledge, of training, and of study.

BY the will of the late Mr. Gordon McKay, inventor of the sewing machine that bears his name, Harvard University receives a very large bequest for applied science, estimated to be about 800,000*l*., and eventually much more. We learn from *Science* that according to the terms of the will, Harvard University is to receive 200,000*l*. when this amount has accumulated from the income, and is thereafter to receive 80 per cent. of the balance of the income after annuities have been paid, and is to receive the entire residue of the estate after the death of the last surviving annuitant. The portion of the will defining the object of the bequest is as follows:—The net income of said endowment shall be used to promote applied science. First, by maintaining professorships, workshops, laboratories and collections for any or all of those scientific subjects which have, or may hereafter have, applications useful to man; and, second, by aiding meritorious and needy students in pursuing those subjects, especially in connection with mechanical engineering. *Science* also states that under the will of Sarah B. Harrison, Yale University is given 20,000*l*. in memory of her brother, the late Gov. Henry B. Harrison, of Connecticut, who for thirteen years was a member of the Yale Corporation. The money is given in trust, the income to be used for such purposes as the university shall desire.

A BILL to carry out the recommendations of the Universities Commission, those recommendations having been accepted by the Government of India after consultation with the local administrations, was introduced by the Hon. Mr. Raleigh on November 4 to the Supreme Legislative Council of India. We learn from the *Times* that the Bill reduces the number of ordinary fellows to 100 in the case of the senior universities, and to 75 in the cases of the Allahabad and Punjab Universities. The "syndicate" is also to be reduced in membership, so as to make it a compact working body, to be recognised as the executive authority of the university entrusted with certain powers independently of the Senate. The existing members of the Senate will be continued merely as honorary fellows, and be divested of any share in the active business of the university, excepting the right to vote for legislative or municipal representatives. The privilege of electing fellows will be maintained in cases where it exists. It will be for the Government to decide as to the extension or withdrawal of the affiliation of colleges, the function of the university in this respect being merely advisory. Sir Denzil Ibbetson announced that, with the approval of the Secretary of State, it had been decided to make for five years special grants-in-aid to universities and colleges the claims of which to special assistance in carrying out the contemplated reforms are established.

DR. FREDERIC ROSE, His Majesty's Consul at Stuttgart, has made another report to the Foreign Office on technical instruction in Germany. This report is published as No. 600 in the miscellaneous series of diplomatic and consular reports, and is concerned with the building and engineering trades' schools, the aims, organisation and equipment of the Baugewerkschulen being described. Dr. Rose gives very instructive accounts of the schools of this kind in Stuttgart, Karlsruhe, and Nuremberg, and concludes with a history of the development of similar technical institutions in Prussia. These building and engineering trades' schools play an important part in German technical education, being intended, not to train captains of industry, but rather subaltern officers and the rank and file of the industrial army. The schools are in some cases State schools, in others municipal schools. In Prussia nineteen out of twenty-two existing are State schools. The instruction is given both in winter and summer in some schools, in others during the winter months only. It varies to a certain extent at the various schools, both as regards duration and extent. For example, Prussian schools possess four classes of half a year each for building, whilst Nuremberg possesses five, and Stuttgart and Karlsruhe six classes for the same purpose. As illustrative of the aims of these schools, reference may be made to that at Stuttgart, where in the building departments instruction suitable for the following workers is given:—practical master builders, subordinate building officials, road and street inspectors, fire prevention inspectors, railway inspectors, and hydraulic engineering *techniker*; in the mechanical engineering department to managers of workshops and factories, overseers, machine draughtsmen, &c.; and in the surveying department to public surveyors and drainage and irrigation supervisors.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, November 19.—"On the Rapidity of the Nervous Impulse in Tall and Short Individuals." By Dr. N. H. **Alcock**. Communicated by A. D. Waller, M.D., F.R.S.

While the effect of varying conditions on the rapidity of transmission of the nervous impulse has been fully studied, no research has yet been made as to whether the stature of the individual and the corresponding difference in the lengths of homologous nerves have or have not any influence on this rapidity, and as recent work has rendered it desirable that the question should be considered, the research here recorded was undertaken to this end.

Two series of observations were made:—(1) On the frog; (2) on man.

The results lead to the following conclusions:—

(1) The rapidity of the nervous impulse *per unit length* is the same whatever be the stature of the individual.

(2) The time taken by this impulse to travel from the centre to the periphery is greater in taller individuals.

(3) The nodes of Ranvier exercise no influence on the rate of impulse.

Physical Society, November 27.—Dr. R. T. Glazebrook, F.R.S., president, in the chair.—Mr. Horace **Darwin** exhibited an electric thermostat. The thermostat shown at the meeting was made for Lord Berkeley, and is similar to one made for the spectrograph of the 24-inch refractor of the Royal Observatory, Cape of Good Hope. The vessel the temperature of which is to be maintained constant is surrounded by oil contained in a bath. In the oil are placed two heating-coils, through which electric currents pass. By automatically controlling these currents the temperature of the oil, and consequently of the inner vessel, is kept very nearly constant. The control is effected by means of a Wheatstone-bridge in the outer oil-bath. This bridge has two opposite arms of copper and two of manganin, so that it is only balanced at some definite temperature. Its deviations from balance affect the position of a long horizontal boom attached to the suspended coil of a galvanometer. The position of the boom determines the greater or less descent of a "hit or miss" arm which is periodically raised by a rotating-cam, and can only fall to its lowest position when the galvanometer-boom is to one side and allows it to pass; this position of the boom corresponds to a fall of temperature of the controlling-bridge. Thus the position of the "hit or miss" arm at its lowest position depends on the temperature, and it is the variation of this position which regulates the amount of current passing through the heating-coils. The thermostat supplied to the Cape Observatory is capable of keeping the temperature within 1/100° C. for a period of eight hours.—On the occurrence of cavitation in lubrication, by Mr. S. **Skinner**. The experiments described in the paper arose from an observation made when determining the refractive index of a liquid by means of Newton's rings. As Newton showed, the rings can be obtained when a liquid is run into the space between the lenses. If when the liquid has been introduced the upper lens be rolled on the lower, the observer sees following the central dark spot a crescent-shaped space, very bright provided the illumination be sufficiently oblique. This is a vacuous or vapour-filled space, for when the motion of rolling ceases the liquid flows into the space and completely fills it. The inflow of the liquid depends in some way on the viscosity, and the effects are more pronounced when a more viscous liquid is used. The most convenient mode of observation is to use a deeply-coloured liquid, and to look at the space by transmitted light. The author has found that a convenient liquid is a strong solution of fuchsin in glycerin. The cavities which are formed must be produced either by splitting the liquid itself or by tearing the liquid from the glass surface. The effect may be described as a case of "cavitation." Some experiments were made to imitate the actual case of a fully lubricated axle rotating under a bearing. In ball-bearings completely immersed in oil, the experiments show that there must be a small cavity near the point of nearest approach of each ball to its neighbours, and also to the surface on which it is running. As the friction of the bearing is the viscous friction of the oil, it follows that the friction must be considerably reduced by the formation of these cavities, which are filled with relatively non-viscous vapour. The high lubricating property of oils owes its origin not only to their superior viscosity, but also, possibly, to the facility with which cavities may be formed in them.—Prof. R. **Threlfall** exhibited and described the following instruments which he has used in the testing of electric generators by air calorimetry:—(1) A "hot-wire voltmeter" accurate to 1/100 volt. The wire in this instrument is very fine, and special precautions are taken to keep the tension on it constant, so that the elongation measured is due only to the expansion of the wire caused by the heating effect of the current. (2) A "Pitot tube" for the measurement of air velocity, the velocity being proportional to the square root of the pressure produced in the tube. (3) A "manometer" for determining pressure differences in Pitot tubes with accuracy. This consists essentially of two bottles containing coloured water, which are connected by a syphon, and the air-space of each bottle is put in communication with

its appropriate tube. The readings are taken by setting a pair of needle-points just to touch the liquid surface, and then measuring how they differ in level by micrometer screws, or by callipering suitable jaws. The instrument is trustworthy to 0·01 mm. of water-pressure. (4) A multiplying pressure-gauge in which the motion of a float or ball is used to operate a finger moving round a dial. The dial is divided in such a manner that the square roots of the pressure-differences are read off. Air velocities are therefore given directly.

Geological Society, November 4.—Sir Archibald Geikie, F.R.S., vice-president, in the chair.—Metamorphism in the Loch-Lomond district, by Mr. E. Hubert **Cunningham-Craig**. The area dealt with includes all the Highland rocks on either side of the loch, as well as the area lying to the eastward. Each stage of the progressive metamorphism can be studied without confusing its effects with those of another process. The rocks from the Leny-Grit group and the Aberfoil-Slate group show dynamic metamorphism, and at Rudha Mor the beginning of the thermal type is seen. This is superseded by a constructive metamorphism, probably of hydrothermal type, and the rocks become more highly crystalline, until all clastic structures are obliterated. The segregation of like minerals into folia, the total recrystallisation, and the genesis of new mineral-groupings, result in the production of coarsely-crystalline albite-gneisses from siliceous and felspathic grits.—On a new cave on the eastern side of Gibraltar, by Mr. H. D. **Acland**. This cave is situated south of the eastern end of the tunnel, which pierces the Rock from the dockyard on the western side to "Monkeys' Quarry" on the eastern. The main hall is about 70 feet high and 45 feet wide, and has a smooth stalagmite floor resting on breccia, and a stalactitic roof covering the limestone of the Rock. Its floor falls to a point 19 feet above sea-level. The lower gallery descends at its far end to little short of sea-level. Its floor consists of stalagmite resting on calcareous sand; this on coarse sand, followed by rubbly and calcareous grit, which in time rests on the rock-floor at a depth of 15 feet. In the calcareous grit are well-rounded stones, some pierced by pholades. At a depth of 13 feet were echinids and barnacles. Two other galleries were explored, and in these the walls are pitted to a height of 28 feet above sea-level. The author concludes that the cave existed at first as a fissure, to which the sea obtained access for a long period, and during this period the rock was elevated some 42 feet. The cave was closed to the sea at a period geologically recent, and the breccia and sand-slopes date from a still more recent period.

Linnean Society, November 5.—Prof. S. H. Vines, F.R.S., president, in the chair.—Dr. W. G. **Ridewood** exhibited the frontal bones of a horse showing rudimentary horns. The bony protuberances were about three inches apart, and were set upon the curved ridges that constituted the anterior margins of the areas of origin of the temporal muscles. In the natural sloping position of the head in the living horse they would have been vertically above the orbits. Dr. Ridewood pointed out that the exceptional cases of horny bosses occurring in horses could hardly be regarded as instances of reversion, for the palæontological record of the evolution of the horse is remarkably complete, and no indications of horns are to be found in the extinct congeners of the modern equines.—Prof. **Weiss** exhibited some preparations and photographs of a mycorhiza or mycorhizome from the Coal-measures. The preparations were in part from the Cash collection at the Owens College, Manchester, and in part from Dr. Scott's private collection. They showed the existence in a small root-like organ of fungal filaments presenting all the appearances of those found in the roots of many orchids and in the rhizome of Psilotum.—Mr. B. H. **Bentley** exhibited a large series of lantern-slides, designed for teaching purposes, which he had taken, illustrating certain types of floral pollination, and bees and other insects in actual operation.—Mr. L. A. **Boodle** read a paper on the structure of leaves of the bracken, *Pteris aquilina*, in relation to environment. It is well known that in dry exposed situations the bracken produces leaves of a hard dwarf habit, while in very sheltered localities the leaves are quite soft. This difference in external characters is accompanied by a difference in structural characters. The exposed leaf has a hypoderm, and is a distinctly xerophytic "sun-leaf"; the other type of leaf is a pronounced "shade-leaf," having no hypoderm, and weakly developed palisade-tissue or no definite palisade. A similar difference may occur in different leaves of the same plant, or in different parts of the same leaf when shelter and exposure are sufficiently localised. A slightly xerophytic plant, when transferred to a greenhouse, produced shade-leaves only (though the illumination was fairly strong), and in these leaves the indusia were considerably reduced. The bracken is thus very plastic in its relation to environment.—A paper by Mr. E. P. **Stebbing**, on the life-history of a new Monophlebus from India, with a note on that of a Vedalia predaceous upon it; with remarks on the Monophlebinæ of the Indian region, was, in the absence of the author, read for him by Mr. G. S. Saunders. Up to 1901 only five species of the genus Monophlebus were known as Indian, and four of these were described from the male insect only; in that year the writer discovered both sexes of two new species, which had been named by Mr. E. Ernest Green, Government entomologist, Ceylon, *Monophlebus Stebbingi* and *M. Dalbergae*, whilst a third species, of which the females alone are known, was named *M. Tectonae*. These coccids infest forests in large numbers, and in consequence their ravages are serious. The amount of nutriment withdrawn from the trees is extraordinary, and the extruded sugary fluid may be heard falling like rain in an infested forest. The predaceous *Vedalia Guerinii*, Crotch, was then described, and its method of attack and great voracity; in turn, it is parasitised by a small fly whilst in the larval stage.

PARIS.

Academy of Sciences, November 25.—M. Albert Gaudry in the chair.—The relation between sun-spots and terrestrial magnetism. The utility of continual registration of the variable elements of the sun, by M. H. **Deslandres**. After a critical examination of the various hypotheses which have been put forward to connect solar phenomena with magnetic storms, the conclusion is arrived at that the solution of the problem has not yet been reached.—On the geological significance of anomalies in gravity, by M. **de Lapparent**. It is generally accepted that gravity is in excess of the average in oceanic regions, and is below the average on land. The suggestion is made, in opposition to the views of M. Faye, that the observed anomalies are due rather to the effect of dislocation than of the low temperature of the ocean floor.—On the reinforcement of the action of the bundle of light rays upon the eye, when accompanied by the *n*-rays, by M. R. **Blondlot**. It has been shown in previous papers that a feebly illuminated object increases in brightness when the *n*-rays are allowed to fall on it. It has now been found that if the *n*-rays are directed towards the eye instead of the object, a similar reinforcement is observed.—M. Émile Bertin was elected a member in the section of geography and navigation in the place of the late M. de Bussy.—On functional equations and the theory of divergent series, by M. L. **Fejer**.—On a system of three functions of real variables, by M. **Pompeiu**.—On the possibility of sustaining in the air an apparatus employing a helix, using an internal combustion motor, by M. Charles **Renard**. The reduction in the weight of an internal combustion motor per horse-power developed, now brought as low as 2·5 kilograms per horse-power, renders possible the use of a light helix in an aërostat. The theory is given for the conditions necessary in practice.—On the measurement of the effect of electric waves at a distance by means of the bolometer, by M. G. **Tissot**. The use of a bolometer as a detector has given readable results at a distance of 40 kilometres. The most advantageous arrangement of the apparatus has been worked out experimentally.—On the colour of aqueous solutions of methyl orange and the change produced by acids, by M. P. **Vaillant**. Simultaneous observations of electrical conductivity and molecular absorption (measured with the Gouy spectrophotometer) show that neither the theories of Ostwald nor of Küster are completely in accord with fact. The results point to a progressive molecular transformation of methyl orange under the action of acids, the change being more rapid with the stronger acids.—The modes of deformation and fracture of iron and mild steel, by MM. F. **Osmond**, Ch. **Frémont**, and G.

Cartaud.—Influence of the gases on the separation of metals by electrolysis: the separation of nickel and zinc, by MM. **Hollard** and **Bertiaux.** The introduction of a sulphite, preventing the evolution of oxygen at the anode, permits of the easy separation of nickel from zinc by electrolysis. Experimental analyses are given.—On oxalacetic acid, by M. L. J. **Simon.** The ether is treated with concentrated hydrochloric acid; the free acid, which is insoluble in this liquid, separates completely in about forty-eight hours.—The condensation of the salts of dinaphthopyryl with phenols, by M. R. **Fosse.**—The synthesis of nicotine, by M. Amé **Pictet.** Starting with nicotinic acid, this is converted into β-aminopyridine, the dry distillation of the mucate of this base giving a N-pyridyl-pyrrol. The vapours of this substance, passed through a red-hot tube, give α-pyridyl-pyrrol, which is methylated, giving the isodipyridine of Cahours and Étard (the nicotyrine of Blau). This gives inactive nicotine on suitable reduction, and from this an alkaloid identical in all respects with natural nicotine was obtained in the usual way with dextrorotatory tartaric acid.—The morphogenic action of water in motion on hydra, by Mme. S. **Motz-Kossowska.**—On the function of certain figured elements in *Sipunculus nudus*, by M. F. **Ladreyt.**—On the medusa of Victoria Nyanza, by M. Ch. **Gravier.**—On a double fusion of the membranes in the zygospore of Sporodinia, by M. Paul **Vuillemin.**—On a bacterial disease of the beetroot causing yellowing, by M. G. **Delacroix.** This disease attacks both the forage and sugar beet; practical suggestions are given with a view to its prevention.—On the formations of the zone of quartzites and conglomerates below the Devonian in the Northern Urals, by MM. L. **Duparc** and F. **Pearce.**—On the structure of the Hohe Tauern, in the Tyrolese Alps, by M. Pierre **Termier.**—Contribution to the study of the sodic rocks of East Africa, by M. H. **Arsandaux.**—The volcanic rocks of the island of Eubea, by M. **Deprat.**—The morphogenic action of crotaphytic muscles on the skull and brain of the Carnivora and Primates, by M. R. **Anthony.**—Comparison between the nervous effects of the Becquerel rays and those of light rays, by M. Georges **Bohn.** The action of radium rays upon the teguments is very complicated, acting upon the peripheral nervous filaments, producing a kind of anæsthesia.—On the existence in the animal organism of a diastase possessing simultaneously both oxidising and reducing actions, by MM. J. E. **Abelous** and J. **Aloy.**—On the marsh gas fermentation and the ferment which produces it, by M. **Mazé.** From a fermenting mass of dead leaves a specific organism has been isolated capable of producing methane during the fermentation of suitable solutions.—On tuberculins, by M. **Beraneck.**—A Crookes bulb for radiotherapy, by M. **Audin.** A description of an X-ray tube specially adapted for the treatment of cancer of the mouth and throat.

DIARY OF SOCIETIES.

THURSDAY, December 3

Royal Society, at 4.30.—On the Fructification of *Neuropteris heterophylla*, Brongniart: R. Kidston, F.R.S.—Histological Studies on Cerebral Localisation: Dr. A. W. Campbell.

Linnean Society, at 8.—On Littoral Polychæta from the Cape of Good Hope: Dr. Arthur Willey, F.R.S.—Notes on *Myriactis Areschougii* and *Coilodesme californica*: Miss May Rathbone.

Röntgen Society, at 8.30.—The Production of Photographic Reversal under the Combined Action of various Radiations: C. E. S. Phillips.

Aëronautical Society, at 8.—Report of the International Kite Competition—(1) Mathematical Portion: Prof. C. V. Boys, F.R.S.; (2) Descriptive Portion: Eric Stuart Bruce.—Preliminary Communication on the Longitudinal Stability of Aëroplane Machines: Prof. G. H. Bryan, F.R.S., and W. E. Williams.—The Balloon Ascents made by the late Mr. James Glaisher, F.R.S., for Scientific Purposes: W. Marriott.—The Mechanical Imitation of Bird Flight: W. Cochrane.

Chemical Society, at 8.—On the Molecular Formulæ of some Fused Salts as Determined by their Molecular Surface Energy: J. F. Bottomley—Acid Salts of Monobasic Acids: R. C. Farmer.—The Atmospheric Corrosion of Zinc: G. T. Moody.—The Solubilities of the Hydrates of Nickel Sulphate: B. D. Steele and F. M. G. Johnson.

FRIDAY, December 4.

Geologists' Association, at 8.—On Land, Freshwater and Estuarine Deposits, with Special Reference to Recent Excursions; Lecture by the President, Mr. H. W. Monckton.

Institution of Civil Engineers, at 8.—Artificial Draught, as Applied by Fans to Steam Boilers: W. H. A. Robertson.

MONDAY, December 7.

Society of Arts, at 8.—The Mining of Non-Metallic Minerals Bennett H. Brough. (Cantor Lectures. III.)

Faraday Society, at 8.—Total and Free Energy of the Lead Accumulator: Dr. R. A. Lehfeldt.—Bitumen in Insulating Compositions, Part i.: D. A. Sutherland.—Notes on Aluminium Welding: Sherard Cowper Coles.—Electrochemical Installation at the Borough Polytechnic Institute: Dr. F. M. Perkin.

TUESDAY, December 8.

Institution of Civil Engineers, at 8.—Discussion of Paper on the Distribution of Mean and Extreme Annual Rainfall over the British Isles: Dr. H. R. Mill.

WEDNESDAY, December 9.

Society of Arts, at 8.—Furnaces suitable for Jewellers' Work, Enamelling, Art Casting, and other Similar Industries: Henry H. Cunynghame.

THURSDAY, December 10.

Mathematical Society, at 5.30.—Proof of a Formula in Elliptic Functions: Mr. R. J. Dallas.—On Many-valued Newtonian Potentials: Prof. A. C. Dixon.—A Generalisation of Neumann's Expansion of an Arbitrary Function in a Series of Bessel's Functions: Rev. F. H. Jackson.—Modes of Convergence of Infinite Series of Functions of a Real Variable: Dr. E. W. Hobson.

Institution of Electrical Engineers, at 8.—Presentation to representatives of the Borough of Colchester of a historical picture representing Dr. Gilbert in the act of showing his electrical experiments to Queen Elizabeth and her Court.—The Slow Registration of Rapid Phenomena by Strobographic Methods: the "Ondographe" and "Puissancegraphe" (Wave Recorder and Power Recorder): M. E. Hospitalier.—The Magnetic Dispersion in Induction Motors, and its Influence on the Design of these Machines: Dr. Hans Behn-Eschenburg.

Society of Arts, at 4.30.—India's Place in an Imperial Federation: J. M. Maclean.

CONTENTS.

THURSDAY, DECEMBER 10, 1903.

BUDDHISM IN INDIA.

Buddhist India. (Stories of the Nations Series.) By Prof. Rhys-Davids. Pp. xv + 332. (London: Fisher Unwin, 1903.) Price 5s.

THE keynote to Prof. Rhys-Davids's work on Buddhist India is to be found in his preface. He presents to us a picture of Indian social existence at the time when Buddhism first dawned on the world, avowedly depicted from the point of view of the Rajput rather than from that of the Brahmin. Nor is any apology needed for assuming this position. A history of England completed entirely from such references to its social and economic condition from time to time as might be found in the theological treatises of eminent churchmen would certainly not be regarded as satisfactory, and it is an immense gain to our power of realising past problems of Oriental life and civilisation that the learned professor should have been able to marshal so many points of valuable information from independent lay sources, and to give us new views from a new standpoint. He is at great pains to show the real position which the priesthood of India held in the seventh century A.D., when the world was ripe for Buddhism; and he deduces from an analysis of Pali writings (previous to the general adoption of Sanscrit as the classical language of literature) a very clear idea of early Brahminism in days when the alphabet, indeed, had long been introduced to India from Mesopotamia, but when "literature" existed in men's memories and not in the concrete form of manuscript. All this part of the book is excellent. We see the Kshatriyas—of the noble "colour" (not caste)—in their proper position of relative importance to the Brahmin, and the latter by no means enjoying that social status of dominant and arrogant priesthood which we have always been accustomed to regard as even more distinctive of early Brahminism than of the Brahminism of to-day.

The early Brahmin is now to be regarded as the thinker and learner, the philosopher and minister, ready to adapt his views to those of the public if necessary, with wide toleration seeking to preserve his influence by the adoption of elastic principles. His very gods changed with the times, and both free-thinking and free discussion were not only permitted, but encouraged to an extent probably unparalleled in the history of the world. The soul of the Upanishads had already become the one primeval world-soul from which all other souls emanated, when Buddhism arose; and the remarkable feature about this approximation to a great central truth was that it owed its existence, not to Brahmin philosophy, but to the conception of lay speculation. Thus Buddhism entered the world at the right psychological moment. The world of India at least was ready for it.

But deeply interesting as is this scholarly inquiry into the conditions of literature and religion which prevailed at the time of Buddha's birth, perhaps a little too much space in what is necessarily a crowded work has been devoted to it. It is true that we have graphic pictures presented to the imagination of village and town life, of social intercourse and the relations subsisting between the various grades of a society in which caste distinctions were real enough, but possibly not more pronounced than analogous distinctions in European countries at the same date; but they are restricted to Buddhist India, which was, after all, only a part of India, and we have very scanty glimpses of the relations existing between Buddhist India and the rest of the continent. Nor does the book much assist us to define the geographical boundaries of Buddhist India.

Buddhism was the paramount faith only at certain centres; these centres were far apart, necessitating long and weary pilgrimages from one to another. The earliest Buddhist records contain a "stock" list of the sixteen Powers which constituted Buddhist India, but this list is geographically deficient, for it ignores the whole of south India and Ceylon, and only deals with the area of northern India bounded by the Himalayas on the north, the Vindhyas on the south, the Ganges on the east, and the mountains beyond the Indus on the west. Undoubtedly the most remarkable feature about Buddhism is its absolute extinction in India, the land of its birth, at the hands of the Brahmins, and its extraordinary development in countries beyond India, where it is still a living and a proselytising faith. The connection between Buddhist India and the countries of the borderland, the gradual spread of the faith to the valley of the Kabul River and beyond Kabul to Bamian and Haibak; or to the Swat Valley and Dir, and over the Himalayas to the cities (now buried beneath the sand) of Khotan, would have been an interesting subject of inquiry, for it would illustrate the enormous influence of Buddhist India in the process of civilising the rest of Asia.

The apostles of Buddhism claim that it has been the greatest civilising agent in the world. It has left no mark in India—what has it done elsewhere? Long after the Mohammedan wave of conquest swept through Sind to the Punjab in the eighth century A.D. we know that a Buddhist province of Sind (called Bodh) still retained its infidel proclivities, and the capital of it (Gandhar or Kandhar) is not far from the Gandāva of to-day. Buddhist priests had ruled at Las Bela, where Buddhist caves are to be found near by. Was this the last stand made by Buddhism on the Indian side of the mountains west of the Indus?

There is a passage in the book which might be misunderstood. It is said of the fifteenth of the sixteen "Great countries"—or Powers—that

"Gandhāra, modern Kandahar, was the district of eastern Afghanistan, and it probably included the north-west of the Punjab. Its capital was Taxila."

Gandhāra *was* the north-west of the Punjab (as rightly shown in the little sketch map at the end of the book), but it had nothing to do with "modern Kandahar," or even with that other ancient Kandahar (or Kandhar) of which we have just spoken. It was the almost universal goal of the pilgrims from China who flocked in large numbers through the then open routes of Takla Makan in Chinese Turkesan, across

the Hindu Kush, and through the terrible passes and defiles of Darél to the lower Swat Valley and to the monasteries and monuments of the Punjab.

It would have been interesting, too, if something of the northern art of Buddhist India had been illustrated, as well as the sculptures of Sanchi. It is in the north that the Greek influence is so marked in sculptural art as to render it quite distinct in character from the rude and riotous productions of the indigenous artist of the south, probably educated in Hindu schools.

But it is impossible within the limits of a popular historiette to compass more than a cursory account of so astonishing a moral phenomenon in the world's history as the rise of Buddhism and its marvellous outspread; or to present a view of Indian existence other than that which marked certain phases of its career. Prof. Rhys-Davids has done invaluable service in illustrating the earliest phase of Buddhist inception, and in giving to the world a far more lucid idea of the character of the three great Buddhist kings and heroes —Chandragupta, Asoka, and Kanishka—than is to be found elsewhere in the popular literature of the day. For it is only a great scholar who could have done this so well.

The work is scholarly throughout, as well as popular, and fully maintains the high standard of the fascinating series of "stories" of which it forms a noteworthy unit.

ACETYLENE.

Acetylene: its Generation and Use. By F. H. Leeds and W. J. A. Butterfield. Pp. x+276. (London: C. Griffin and Co., Ltd., 1903.) Price 5*s.* net.

THE steady advance made during the past few years by this beautiful illuminant fully justifies the production of the practical handbook which Messrs. Leeds and Butterfield have now placed before the public.

In this work they have described and explained the physical and chemical phenomena attending the generation and combustion of the gas, and also its employment in the various directions in which it has of late been used.

The subject is thoroughly dealt with, and the book contains an enormous amount of information and common-sense advice, the only general criticism that can be urged against it being, perhaps, that of the occasional repetitions which are inseparable from dual authorship.

In the introductory chapter, whilst considering the advantages of acetylene as an illuminant, the authors deal with a point which, up to the present, has been too much overlooked with regard to illumination by flames, and that is the importance of the action that these have in burning up and destroying considerable quantities of the organic impurities present in the air of an inhabited room, a function which is of the utmost importance, and the absence of which is a considerable factor in the unpleasant nature of the atmosphere often found in rooms lighted by incandescent electric lamps.

An interesting feature is also to be found in the authors' attempt to compare the relative merits and cost of lighting by various illuminants on the basis of illuminating effect rather than illuminating power. That this difference does exist as a most important factor in illumination has long been recognised, and a moment's consideration will convince anyone that although a particular burner may yield a light of 25 candles, it will not be in any way equivalent in its power of effectively lighting a room to 25 candles distributed over the area of the room. If a satisfactory unit of comparison and an accurate method of determining the results could be obtained, this method of comparison would offer enormous advantages over the ordinary photometric method.

In compiling the table the authors have taken as the standard of a well-lighted room the being able to read with ease ordinary print in every part of it, but it is clear that so much depends upon the personal factor that whilst one observer may look up a train in Bradshaw with ease and comfort, another might find a difficulty in dealing with fair-sized print, and on such a basis it is hard to found a satisfactory unit of comparison.

In dealing with the physics and chemistry of the actions taking place between carbide and water in the generation of acetylene, the whole question is very carefully and thoroughly treated, but in referring to the power of water in dissipating the heat generated during the action, a little too much stress is laid on the power of water in keeping down the temperature. The statement that

"if an excess of water is employed in an acetylene generator the temperature inside can never, except quite locally, exceed 100° C. however fast the carbide be decomposed"

is although perfectly correct, a little misleading. The importance of reducing the temperature in an acetylene generator to the lowest possible point is to prevent the formation of certain compounds which afterwards give rise to trouble in the consumption of the gas, and with a large generator of the type in which carbide is fed into water, although the water may be in very large excess, it is by no means unusual to find in the centre of the decomposing mass on the bottom of the apparatus a temperature capable of melting lead, this being due to the fact that when the carbide is fed in in large quantities, a crust of lime forms on the outside of the mass which becomes toughened by tarry products formed by the heat on the acetylene generated in the interior of the mass, and this partly by acting as a non-conductor and partly by keeping the carbide away from the large excess of water, allows an undue rise of temperature, and the acetylene generated is found as a result to contain considerable amounts of products of polymerisation.

In referring to the combustion of acetylene and its illuminating power, the authors conclude that it would be clearer to state the illuminating power of acetylene as 48 candles per cubic foot, rather than by accepting the arbitrary nomenclature of gas photometry to speak of it as 240 candles, inasmuch as in determining the illuminating power, the gas has to be burnt at the rate best suited for developing its light-giving properties, and the results so obtained calculated to a consumption of 5 cubic feet.

It is not clear, however, that the statement of 48 candles per cubic foot would not be equally misleading, as the light emitted from good acetylene burners varies enormously with the rate at which the gas is consumed, so that with small burners the illuminating value of the gas is rarely more than 20 candles a foot, whilst with 1-foot burners it is a remarkably good burner that gives 42 candles per cubic foot of gas consumed.

In referring to the formation of carbonaceous growths at the burner tips, the authors point out that although this has been put down to the action of heat on polymerisation products in the acetylene, yet that if this were the case the trouble should disappear entirely if the gas were washed with heavy oil before entering the burners, this procedure, however, not giving entire freedom from the trouble. In this criticism, however, they evidently overlook the fact that not only does polymerisation of the acetylene take place where there has been undue heating in the generator, but that no matter how thoroughly the gas may be purified before reaching the burner, a further, though small, polymerisation will take place in its flow through the heated steatite tips at which it is burning, and that the trace of benzene so formed is quite capable of giving the trouble.

The practical details given as to size of pipes and other points upon which little or no knowledge exists amongst generator makers are of the greatest value, and the book may be most heartily recommended to all interested in the production and use of acetylene.

THE TSETSE FLIES.

A Monograph of the Tsetse Flies (Genus Glossina, Westwood). Based on the Collection in the British Museum. By E. E. Austen, with a Chapter on Mouth-Parts by H. J. Hansen, Phil. Doc. Pp. ix+319. (London: Printed by Order of the Trustees, 1903.) Price 15*s*.

SOME fifty years ago J. O. Westwood gave a description of a "destructive species of dipterous insect known under the name of Tsetse," and referred it to the genus Glossina, first established twenty years previously by Wiedemann. From that time onwards references to the tsetse fly and its association with a mysterious disease fatal to horses, cattle, and other animals become very numerous in the writings of travellers and naturalists, and various were the theories propounded to explain the relation of the fly to the disease. Drysdale, in 1879, seems to have been the first to suggest that the tsetse fly disease might be of an infective nature, the infecting agent being conveyed by the bite of the fly. In 1895 and 1897 the well-known reports of Lieut.-Colonel Bruce appeared. He described the tsetse fly disease or nagana met with in Zululand, and established the fact that it is due to a protozoan blood parasite, the *Trypanosoma Brucei*, which is conveyed by the bites of the tsetse fly from affected to healthy animals. As horses and cattle are unable to exist in the districts inhabited by the fly, the problem of transport in these "fly belts" is a serious one, and the tsetse fly and its distribution have assumed great economic importance. In India and Burma there is a similar, if not identical, disease known as surra, which is also conveyed by a biting fly, perhaps a species of Stomoxys.

Within the last few months evidence has been accumulating, through the work of Castellani, Bruce and others, that sleeping sickness, the ravages of which have assumed alarming proportions, may be caused by a trypanosome (*T. Castellanii*) attacking the central nervous system (see NATURE, vol. lxviii. p. 116).

From analogy with nagana and other facts (see NATURE, vol. lxix. p. 34) it would seem probable that a tsetse fly conveys the infection in this disease, and therefore that measures of prevention and extermination directed against the fly might stamp out sleeping sickness. Other diseases also, *e.g.* trypanosoma fever, are caused by species of trypanosomes, and these, too, may very likely be conveyed by tsetse flies.[1]

In view, therefore, of the practical importance of an accurate knowledge of the genus Glossina, the Trustees of the British Museum have been well advised to publish this monograph upon the tsetse flies, the preparation of which has been entrusted to Mr. Austen. We may say at once that Mr. Austen has produced a work which must for some time remain the standard one upon the subject. He gives both a popular and a scientific description of the flies, a full bibliography with copious abstracts, the whole being illustrated with many figures in the text, with a map showing the geographical distribution, with beautiful coloured plates of the seven known species from drawings by Signor Terzi, and with two plates of the mouth-parts of Glossina and Stomoxys. The latter, together with a description, are by Dr. Hansen, and will enhance the value of the volume to the dipterologist.

In the first place it is to be noted that, although the term "the tsetse *fly*" is usually employed, there are at least seven species, so that "tsetse" becomes a *generic* rather than a specific name. By some the original *Glossina morsitans* has been called the "true tsetse." The name "tsetse" is of obscure origin, but is certainly onomatopoetic, derived from the peculiar buzzing sound made by the fly on the wing. The tsetses are confined to Africa, are always met with in the neighbourhood of water, and are often restricted to peculiarly well-defined tracts of country. Mr. Austen's description of them may be reproduced here, since NATURE may reach many who may not have access to this monograph:—

"The tsetses are ordinary-looking sombre brownish or greyish-brown flies varying in length (excluding the proboscis) from $3\frac{1}{2}$ to $4\frac{2}{3}$ lines ($7\frac{1}{2}$–10 mm.) in the case of *Glossina morsitans* to about $5\frac{1}{2}$ lines ($11\frac{1}{2}$ mm.) in the case of *Gl. fusca* or *longipennis*, with a prominent proboscis in all species. The hinder half of the body, or abdomen, in the best known species, though not in all, is of a paler colour and marked with sharply defined dark brown bands, which are interrupted on the middle line; the abdomen, however, is invisible when the insect is at rest, as it is then concealed by

[1] Since the above was written, a further report on sleeping sickness by Col. Bruce has been issued. In this much additional evidence is given of the correctness of these views of the nature of sleeping sickness and of its transference by a tsetse. Trypanosoma fever may be the early stage of sleeping sickness.

the wings. . . . In *the resting position* their identification is easy. In this attitude they can be distinguished from all other blood-sucking Diptera . . . by the fact that the brownish *wings lie closed flat over one another down the back*, like the blades of a pair of scissors, while *the proboscis projects horizontally in front of the head*" (p. 3)

There is one peculiarity of *Gl. morsitans* that may be noted, viz. it does not lay eggs as do the majority of the Diptera, but extrudes a yellow-coloured larva nearly as large as the abdomen of the mother. Whether this process is the same in all species has yet to be determined. Of the seven species of tsetse described, one (*Gl. pallidipes*) is new, and appears to be the East African representative of *Gl. longipalpis*. The work concludes with some valuable appendices of information from travellers, Government reports, the reports of Colonel Bruce and others.

When the transmission of malaria by the mosquito was proved, the authorities of the British Museum rose to the occasion and published the magnificent monograph upon the Culicidæ by Mr. Theobald; again they have not disappointed us. In conclusion we would direct attention to the series of models in the entrance hall of the Natural History Museum of the trypanosome and tsetse fly, and of the malaria parasite and mosquito; they should be studied by all who may have the opportunity of increasing our knowledge of these and other tropical diseases.

R. T. H.

METALLURGY OF STEEL.

Hardening, Tempering, Annealing, and Forging of Steel. By Joseph V. Woodworth. Pp. 288. (Westminster: Constable and Co., Ltd.) Price 10*s*. net.

TO students who have ploughed through the weary sands of recent steel literature, Mr. Woodworth's book will appear somewhat in the nature of an oasis in the desert. The author does not appear to be versed in the "ites" of metallography, or fully to have grasped the allotropic theory of hardening, but, nevertheless, he does thoroughly understand tool-steel. Authors of papers on the restoration by heat treatment of faulty steel will hardly be prepared to acquiesce in a statement made by Mr. Woodworth on p. 18 of his book, namely,

"Heating for forging is, in its way, quite as important as heating for hardening; care and uniformity in the application of heat in the first instance is very essential. Should the steel be over-heated in this process, no amount of care afterwards will restore the steel to its former state or remedy the evil."

With the words above quoted everyone who has had an extensive practical experience of steel metallurgy will be more than inclined to agree.

On p. 24 attention is directed to the fact that steel as delivered from the manufacturer is always more or less decarbonised on the surface.

"For this reason, do not select a piece of steel which will just 'skin' up, but take a piece large enough to require taking a good-sized cut before reaching the finished surface."

This is good advice, not only to mechanics, but also to scientific men making researches on the magnetic properties of steel. Mr. Woodworth, in concise and lucid terms, deals at considerable length with the machining, hardening, and tempering of nearly every class of steel tools, and the value of his letter-press is enhanced by a series of admirable illustrations (chiefly in perspective) of turning tools, taps, reamers, and an excellent set of milling cutters.

A brief illustrated article on muffle furnaces (pp. 92–94) is well worth the attention of British artisans, as showing American practice, which is, on an average, undoubtedly superior to that obtaining in this country.

That portion of Mr. Woodworth's book dealing with the manufacture of dies and of drop forgings must necessarily be interesting to British manufacturers and workmen, because America was the birthplace of drop forgings, which were first manufactured by Colonel Colt, of revolver fame, in 1853.

Another feature of the work now under review is the fairly complete and beautifully illustrated chapter on the emery-grinding of steel tools. Mr. Woodworth advocates as the highest type of forgings material which has been quenched in oil and subsequently tempered to remove contraction stresses. The views he expresses have already found favour with many experienced British steel metallurgists.

On p. 162 Mr. Woodworth leaves, for the time being, a branch of steel metallurgy in which he is evidently a past master, and becomes controversial on the well-worn argument of steel *v.* wrought iron forgings. In deciding upon the superiority of steel, the author perhaps a little overdoes it, and his quotation from the report of the American Government tests on alternating stresses will hardly convince steel metallurgists who have closely studied this matter.

The tests he quotes show that wrought iron is capable of enduring only 50,000 alternations. Steel, with 0·25 per cent. of carbon, endures, before fracture, 229,000 alternations, whilst steel with 0·45 per cent. of carbon sustains almost a million alternations. The author considers that these figures

"have given engineers an idea of the comparative endurance of wrought iron and steel in such service as that to which crank-pins, shafting, &c., are subject."

Had Mr. Woodworth seen a verbatim report of the trial to decide the cause of the disaster on H.M.S. *Bullfinch*, which occupied several days at the King's Bench in the summer of 1902, he would probably have expressed a much modified opinion on the question at issue. Broadly speaking, the connecting rods of the *Bullfinch* were of the higher carbon limit just quoted; the rods of H.M.S. *Snapper* contained about the lower limit mentioned, namely, 0·25 per cent. of carbon. The rods of the *Bullfinch* snapped on her trial trip, causing lamentable loss of life. Those of the *Snapper* were taken out intact after the destroyer had run her trial trips and been four years in commission.

An interesting portion of this book is the description of the Taylor-White process, which was the pioneer of those steels known as "speedy-cut," but quite naturally Mr. Woodworth does not specially direct

attention to the fact that since the inauguration of this process its product has been distinctly eclipsed by steels manufactured in several famous Sheffield works.

Mr. Woodworth's book has been written by an able man, thoroughly interested in his craft, and it is to be hoped that it will find its way into the hands of a large number of British artisans.

J. O. ARNOLD.

OUR BOOK SHELF.

Macedonian Folklore. By G. F. Abbott, M.A. Pp. xii+372. (Cambridge: University Press, 1903.)

THIS somewhat dainty little volume on Macedonian folklore, with its blue and white binding, will be welcomed by many readers, first, because the print and paper are good, and next, because the work is pleasantly written, and every paragraph is of interest. The results collected in the work before us by Mr. G F. Abbott, of Emmanuel College, Cambridge, are the fruits of a series of researches into the folklore of the Greek-speaking parts of Macedonia, carried on by the author under the auspices of the electors to the Prendergast studentship of the governing body of Emmanuel College, Cambridge, and there can be no doubt that the materials here gathered together amply justify the selection of Mr. Abbott for his mission by the powers that be.

The reader or student who is familiar with the sound and solid work of Prof. E. B. Tylor, and the wonderful volumes of his friendly rival, Mr. J. G. Frazer, will not expect to find in this monograph the vast knowledge and mature thought which are so characteristic of the works of these eminent scholars, but it is pleasant to see that the influence of both of them is visible in Mr. Abbott's treatise, and we therefore look forward to other works from his pen with confidence. "Macedonian Folklore" contains nineteen chapters, six appendices, and an index; the last-named section is very short, and we think it should have been made fuller. After a short description of the sources of the facts which he prints, and a narrative of some amusing personal experiences, Mr. Abbott proceeds to deal with the folklore of the Macedonian year, which he treats in four chapters. Many of the saws are familiar enough to us in other forms, but there are several auguries and prophecies about the weather which are worthy of note for comparative purposes.

The section on divination is of considerable interest, and it seems that the Macedonians divine by means of coffee, instead of by tea as Europeans in the west do. The expert will have no difficulty in tracing a connection between some of the divination practices here described with those of many nations, but there are many which have no parallels among other peoples, so far as we know, and these, of course, form one of the most valuable parts of Mr. Abbott's book.

The chapters on birth, marriage, and funeral rites are lengthy, but very interesting, and the numerous extracts which we have from the songs of the people enable us to judge of the accuracy of the deductions set forth in them. The original Greek is given, in all cases, with an English translation, and this plan is a handy one and one to be commended. We cannot refer to details, for want of space forbids, and we therefore pass on to mention the chapters on Alexander the Great and Philip in folk-tradition, to the series of pretty bird-legends which are printed on pp. 291–294, to notes on the game of morra, fire-ordeal, the perils of portraiture, &c., and to the collections of riddles, mystic poems, love-couplets, &c., which bring the book to an end. Mr. Abbott's contribution to the science of Macedonian folklore is opportune, and the modesty of the work and the care with which it has been performed merit praise.

Practical Physics for Schools. I. Mensuration, Mechanics, and Hydrostatics. Pp. 72. II. Light and Heat. Pp. 79. By C. J. L. Wagstaff, M.A., and G. C. Bloomer, B.A. (Cambridge: W. Heffer and Sons, 1903.) Price 1s. 6d. each.

THE authors say in their preface that these notes have been used for the teaching of practical physics at the Bradford Grammar School during the last three years, and the presumption is that experience has proved their usefulness and suitability. An examination of the volumes, however, suggests that the notes have in practice probably been supplemented by judicious additions by the teachers, or the results of the instruction would have been less satisfactory. The volumes contain no illustrations to show pictorially the arrangements of the apparatus described; one page only seems to be devoted to the plotting of curves, and on this page there is by no means enough explanation to explain to a young student the method and meaning of such graphic representation; and, more than this, under the section Boyle's law, the pupil is instructed to plot a curve connecting P and 1/V, and in another place to plot a curve connecting the square root of the length of a pendulum and the time of swing, though the only remarks on curve plotting, instead of preceding these instructions, follow in another experiment. In several places, too, the verbal instructions seem inadequate to the needs of beginners. In describing the screw gauge the authors content themselves by saying that the zero error must be ascertained carefully, and give no directions as to how this should be done. The account of the vernier is similarly too brief. To secure the best results in a physical laboratory the student should be in possession of directions explicit enough to avoid the waste of time caused by waiting for the master to arrive to clear up a difficulty, and these directions should be obtainable from the book or be given in a preliminary demonstration. Notwithstanding the remark of the authors that experimental work in sound is only suitable for a later stage, there are many experiments in this branch of physics that interest young people and are understood by them. On the whole, however, the course is comprehensive and generally in accordance with the experience of good laboratory practice.

Flora of the Upper Gangetic Plain and of Adjacent Siwalik and Subhimalayan Tracts. Vol. i., part i. By J. F. Duthie, B.A., F.L.S. Pp. xvii + 403. (Calcutta: Office of the Department of Government Printing, 1903.) Price 15s.

IT is only by a very liberal interpretation of the term that this book can be referred to as a *local* flora, seeing that it deals with an area of 196,000 square miles, which includes not only the North-West Provinces up to the Subhimalayan slopes, but extends southwards to the Vindhaya Mountains, and thus takes in portions of some dependent States. But as a comparative term, when contrasted with Sir J. Hooker's "Flora of British India," the expression has been applied both to this flora and also to Dr. T. Cooke's "Flora of the Bombay Presidency." A very satisfactory feature of the book is the facility which is offered for obtaining information quickly and easily. A synopsis of the natural orders is given, arranged on principles similar to those which are so well known from Hooker's "Student's Flora," arrangement being based primarily on the characters of the ovary. For each order and genus full descriptions and determining keys are provided, and for the species references, synonyms, locality

and distribution are added. These, in conjunction with a glossary of terms, render the book available to everyone possessed of an elementary knowledge of botany. In addition to the descriptive text, Mr. Duthie has collected into the notes appended to the species a vast amount of information dealing with the identification and economic uses of the plants, both indigenous and cultivated. A perusal of the book not only serves to indicate how large a proportion of the Indian plants possess valuable properties, but also cannot fail to impress one with the comprehensive knowledge which has been acquired by the assiduous work of the author and other botanists in India who have occupied similar responsible positions. This part includes the orders Ranunculaceæ to Cornaceæ; the first volume will extend to the Campanulaceæ, and two volumes will complete the work.

A Laboratory Guide to Qualitative Analysis with the Blowpipe. By F. W. Martin, Ph.D. Pp. iv+47. (New York: John Wiley and Sons; London: Chapman and Hall, Ltd., 1903.) Price 2*s.* 10*d.*

THE author regards the restricted employment of the blowpipe in analysis as due to the lack of a convenient manual or work of reference, which this modest little volume of fifty pages is now intended to supply.

It may be questioned whether, in a well-equipped laboratory, the use of the blowpipe as a delicate instrument for qualitative analysis will supersede other methods. For the mineralogist, and especially for the mining prospector, the classic of Plattner-Richter, which has been translated into English by Cornwall, will always hold its place.

There is nothing in the present volume to call for special notice. The matter is very condensed, occasionally at the risk of becoming confused. This is a description of a coal gas flame:—"Its luminosity is due to superheated, separated carbon set free from acetylene, an easily decomposed gas, which is formed from other hydrocarbons composing the gas used as fuel by the heat of combustion in the outer envelope." One is accustomed to the American spelling of "luster," "vapor," &c., but the omission of the final e in "oxid," "sulfid," "chlorid," &c., if intentional (*oxide* also occurs), is un-English.

J. B. C.

Elementary Experimental Science. Physics. By W. T. Clough. *Chemistry.* By A. E. Dunstan, B.Sc. Pp. vi+239. (London: Methuen and Co., 1904.) Price 2*s.* 6*d.*

THE course of work provided in this little book is intended for young beginners who propose to present themselves for examinations of the standard of the University Junior Locals. The book aims at supplying the necessary general information, and also sufficiently explicit instructions for laboratory work. In the physics section 157 experiments are provided, and in chemistry there are 110, but a number of them are more suitable for lecture demonstrations than for laboratory exercises. A pupil who works through the book, performing the more important of the experiments given, cannot fail to obtain a fair knowledge of the fundamental principles of physical and chemical science.

Notes from a Lincolnshire Garden. By A. L. H. A. Pp. 93. (London: Elkin Mathews, 1903.) Price 2*s.* 6*d.* net.

THESE notes are chatty, interesting, and intelligent. The writer loves the garden and everything that happens in or near it. The book is an instance of the humanising effect of nature-study undertaken for the love of the subject. The little book may be recommended to all lovers of country gardens.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

Heating Effect of the Radium Emanation.

IN a letter to NATURE of November 5, Prof. Schuster has made some remarks on a letter published by us the week previously, containing a brief account of some experiments to show that the heating effect of radium is temporarily reduced by the removal of the emanation, and that the tube containing the emanation separated from the radium shows a considerable heating effect.

The difficulty felt by Prof. Schuster apparently arose from the fact that we included in the heating effect of the emanation not only that due to the emanation itself, but also that due to the secondary products to which the emanation gives rise. It was an oversight on our part to have omitted in the sentence "more than two-thirds of the heating effect is not due to the radium at all, but to the radio-active emanation which it produces from itself," the words "together with the secondary products to which the emanation gives rise." We were fully aware that the heating effect was in part due to the "excited activity" produced by the emanation. We specially mentioned the gradual decay of the heating effect of radium to a minimum in the course of a few hours, and the increase of the heating effect of the emanation tube during the same period. These effects are connected with the gradual decay and rise, respectively, of the excited activity produced by the radium emanation. The results would have little meaning if we believed the heating effect was due to the emanation alone, for, as Prof. Schuster quite correctly points out, the heating effect in such a case should at once drop to a minimum after removal of the emanation, and the heating effect of the tube containing the emanation should not at first increase.

On account of the rapid rise of the excited activity in a tube containing the radium emanation, the separation of the heating effect of the emanation from the complicated secondary changes which result from it is a difficult experimental problem.

Our letter was merely a preliminary announcement of the results of our experiments. It is not possible to discuss the consequences to be deduced from the experiments without entering into a detailed description of the measurements. We hope to publish shortly a full account of our work on the various heating effects.

McGill University, November 20.

E. RUTHERFORD.
H. T. BARNES.

The Pearl-Oyster Parasite in Ceylon.

MR. JAMES HORNELL, who is still in Ceylon carrying on the investigation of the pearl-oyster fisheries which I started in 1902, tells me in a letter just received that he has now succeeded in finding the final stage of the cestode larva which we found to be the nucleus of the best Ceylon pearls. We found this larva (a Tetrarhynchus), in the spring of 1902, in the pearl-oyster, and, later on, what we took to be its later stages in the file-fishes (Balistes) which feed upon the pearl-oysters, and we felt pretty certain (as I stated in the first part of my report, now published) that the adult would be found in Trygon or some other large Elasmobranch. Mr. Hornell writes from Trincomalie, November 16, as follows:—"Just a line to tell you that I have found the final host of *Tetrarhynchus unionifactor*.[1]

"It occurs, as surmised, in one of the large rays—a Trygon, I believe, but I have no work on fishes, and cannot identify at present.

"There is, I believe, practically no doubt as to species, in the stomach of the ray being two Balistes entire, and apparently just devoured, and plenty of bones. In the folds

[1] The name we gave to this Tetrarhynchus larva in our notes and letters until it was ascertained whether the species was known or new.—W. A. H.

of the spiral valve various Tetrarhynchids, *mature*, of two sizes—I fancy of [two] species—which bears out Shipley's belief of 2 species being in Balistes. In the stomach a larval Tetrarhynchid just where a larva should be—the adults being further along the canal."

The rest of the letter, hurriedly written to catch the mail, refers to other matters.

Mr. Arthur Shipley, who is writing a joint paper with Mr. Hornell on the parasites of the pearl-oyster for my report, will no doubt discuss the matter fully later on, when he has examined the specimens, but it is, I think, only due to Mr. Hornell, who is working most energetically in the wilds far from books of reference or any other scientific help, that his interesting announcement should be made public as soon as possible. W. A. HERDMAN.

University, Liverpool, December 9.

The Late Leonid Meteor Shower.

SUSPECTING that the tail or following segment of this swarm, owing to its enormous length, might be outside the sphere of influence of Saturn in 1870, and Jupiter in 1898, the writer kept watch as follows to see how far this suspicion might prove to be correct :—

Friday morning,	November	13,	... ...	Overcast
Saturday ,,	,,	14,	3 to 4	No Leonids
Sunday ,,	,,	15,	12 to 2.30 ...	2 Leonids
			5 to 5.30 ...	No Leonids
Monday ,,	,,	16,	12 to 4.15 ...	Intense shower
Tuesday ,,	,,	17,	... .	Overcast
Wednesday ,,	,,	18,	5 to 5.30 ...	3 Leonids

One of the two Leonids observed at about 12.30 on November 15 diverged with a long, slow motion from Zeta Leonis to below the stars Nu and Zeta, Ursa, giving one the impression of its being an almost "end on" one from near the radiant, while the other, at about 2 a.m., passed high up on the right with a bright flash or streak. A further short watch was kept from 5 to 5.30 with no results; hence the conclusion that the shower would be of no very imposing character. This, however, proved to be incorrect, as on the following morning, November 16, at 12.30, a bright flash overhead, and shortly afterwards two fine meteors diverging right and left from a point near Zeta inside the Sickle, indicated increased activity.

The display rapidly increased, the meteors coming apparently in little flocks or shoals, the majority from an area of, say, 6 degrees by 3 degrees along Leo, with an hourly rate which he estimated as high as from 80 to 100, but this would seem to be below the mark. Between 3 and 4 a.m. several bright meteors diverged upwards and downwards from the Sickle, thus enabling him to fix the radiant as close by its old position at $149° + 22°$. The following morning, November 17, was overcast, but the radiant was still active on November 18, one of the three Leonids observed radiating upwards over Eta from within the Sickle as usual. A remarkable feature was that many of the meteors diverged upwards towards the S.W., whilst others diverged downwards N.E., as if conforming to the ecliptic, an appearance which may have been due to the rotation of the earth, and had been noticed before in connection with other well-known showers. Many of the larger meteors lit up the atmosphere with fine, bright, steel-like flashes.

At 4.15 the sky became overcast, but as he turned in he could still see meteors falling in the west and north-west, and it would appear, from observations made elsewhere, that the maximum occurred during the next two hours, *i.e.* from 4 to 6. It may here be remarked that this shower seemed in previous years to be at its best about an hour or so before daylight, owing, no doubt, to its then high altitude.

Altogether, the display was much above the average, and would appear to have justified the anticipation that the tail end held on its course. At any rate, we get another glimpse into the mechanics of a meteor stream, and more particularly into that of the Leonid, and the distribution around the orbit of the latter, should it still intersect the path of the earth, is a question for the future.

W. H. MILLIGAN.

2 Barronville, Holywood, Co. Down, November 30.

MR. HENRY's letter in your issue of November 26 contains several notable points which confirm my own observations. Being engaged on other work (which entailed long spells within the observatory and the dark room) throughout the night of November 14 and early morning of November 15, I noticed only a few meteors, and, as the sky became overcast here at 4.45 a.m., it is evident that, according to Mr. Denning's account, observations of the maximum display were impossible at South Kensington.

However, on the early morning of November 16, 2.15–3.50 a.m., my watch was rewarded by the appearance of more than fifty Leonids, some of which were exceedingly bright and lasting. Facing the south-east, I had familiar constellations (Orion, &c.) in the field of view, and was consequently able to record the trails among the stars with a fair amount of certainty.

The most striking point on which Mr. Henry's observations are confirmed by mine is that there were decidedly *two* apparent separate radiants, the one very near to, or coincident with, that given by Mr. Denning in NATURE for November 12, and another, from which quite half of the observed meteors seemed to emanate, at about R.A. $= 145°$, Dec. $= +17°$. Several Leonids with short trails were seen quite near to "the Sickle," and indicated by their direction the existence of this second radiant point. One long-trail Leonid occulted ξ Geminorum, and if the trail had been prolonged (it stopped short about two or three degrees from Betelgeuse) it would have passed between α, γ, and $\lambda\phi$ Orionis. The majority of the meteors observed by me passed from the direction of Leo towards Gemini, Orion, or Canis Minor. WILLIAM E. ROLSTON.

Solar Physics Observatory, South Kensington, S.W., December 5.

Weather Changes and the Appearance of Scum on Ponds.

SOME years ago I also observed the phenomenon of a sudden appearance of scum on the surface of a pond similar to that mentioned by "Platanus orientalis" in NATURE, November 5.

The explanation, however, given by Dr. Mill in the same number of NATURE, namely, that the appearance of scum is occasioned by an accelerated flow of springs rising through the chalk of the floor of the pond, does not apply to the case which I have observed. That pond had no springs of the kind, but was fed by a very small and slow creek emptying into the pond at its upper extremity. Although the pond was pretty large, the scum did not appear near the inlet only, but all over the pond at the same time.

I wish to offer the following explanation of the phenomenon so far as it came under my observation, and I am inclined to believe that it applies to the case of "Platanus" just as well.

Our pond was very rich in marsh gas, a fact which could be easily ascertained by thrusting an oar into the soft bottom, when large bubbles of this gas would come to the surface. Now it is quite natural that this gas, slowly generated as it is, within the layer of decaying vegetable matter at the bottom of the pond, will gather in little bubbles, and these in turn will rise, provided they have acquired a sufficient buoyancy to break through their mouldy matrix, tearing off and carrying some of the solid matter up to the surface.

Ordinarily, this will take place all the time at regular intervals, but at a very slow rate, and would, therefore, escape observation. In time of a sudden fall of atmospheric pressure, however, the case is different. Then all the gas bubbles which are more or less ready to rise under normal conditions will suddenly expand and rise simultaneously, carrying upward not only a few isolated particles, but entire layers of soft material. I have often observed this very phenomenon, although I failed to notice the atmospheric condition at the time.

The material itself which was thus thrown to the surface consisted, so far as I can recollect, of black-brown vegetable matter, derived chiefly from leaves that had fallen into the pond, and of a green slime, consisting of numerous algæ.

FRED. J. HILLIG.

St. John's College, Toledo, Ohio, U.S.A.

SOME SCIENTIFIC CENTRES.

VI.—THE CAVENDISH LABORATORY.

SINCE its foundation, the Cavendish Laboratory of Cambridge has held a very prominent position, not only as the home of the teaching of physical science in one of our great universities, but also as the centre of a vigorous and prolific school of scientific research. The history of the laboratory must always be intimately associated with the scientific labours of the three distinguished holders of the chair of experimental phyics in the University of Cambridge, J. Clerk Maxwell, Lord Rayleigh, and J. J. Thomson, each of whom, in his own direction, has exerted an unusually marked influence in the advance of physical science.

The laboratory is of relatively recent foundation in comparison with some of our older scientific centres like the Royal Institution, but yet it may claim to be one of the first of those modern laboratories which have now sprung up in almost all the larger universities where adequate provision is made for the advancement of scientific research as well as for the teaching of science. In 1870 the Duke of Devonshire, who was then chancellor of the university, signified his desire to build and equip a physical laboratory for Cambridge. In his capacity as member of the Royal Commission of Education, he had recognised the value of such an institution. The chair of experimental physics was founded as a result of this offer in 1871, and in the same year James Clerk Maxwell was appointed to the position. It was enacted that it should be "the principal duty of the professor to teach and illustrate the laws of Heat, Electricity, and Magnetism; to apply himself to the advancement of the knowledge of such subjects; and to promote their study in the University."

For several years after his appointment Maxwell was occupied in designing and attending to the construction of the laboratory, and equipping it with suitable apparatus. The building was not ready for work until 1874, when the chancellor of the university formally presented his gift to the university.

The laboratory is an unpretentious solid three story building of stone. At the present time the ground floor is taken up partly by a series of rooms devoted to research and by a large and admirably equipped workshop and a small battery room. One of these rooms was for many years used by Dr. Glazebrook, secretary of the British Association Committee of Electrical Standards, as a standardising laboratory, and here were kept the electrical standards of the Association. On the walls, as one ascends the stone stairway, hang a painting of the founder, a picturesque print of Cavendish, that eccentric man of science who did such admirable electrical work more than a century ago, a small painting of Maxwell, and fine enlarged photographs of Lord Rayleigh, Sir George Stokes, and Lord Kelvin. The first floor is occupied by a large laboratory for practical work, a lecture and preparation room, and a neatly arranged apparatus room. Here are kept some scientific apparatus of unusual historic interest, including the original British Association revolving coil, with which the first determination of the value of the ohm was made, the revolving coil used by Lord Rayleigh for the same purpose, and the oscillation apparatus used by Maxwell in his determination of the viscosity of gases. Among many other pieces of apparatus devised by Maxwell may be mentioned his model for illustrating the induction of electric currents, and spinning tops and plaster casts made by his own hands to illustrate Willard Gibbs's heat surfaces. The second floor consists of a laboratory devoted to advanced practical work and four research rooms. In 1896, on account of lack of accommodation, another wing was built to the laboratory. This includes a large well-lighted laboratory devoted to the practical work in physics of the medical students, a small lecture room, several smaller research rooms, and a basement which can be used as a constant temperature room.

The laboratory, at the time of its foundation, was one of the largest and best equipped then in existence. The fame of Maxwell immediately attracted round him men eager to undertake research under his guidance. Among others, it is interesting to recall the well-known names of Chrystal, Garnett, W. D. Niven, Schuster, and Gordon. One of the first pieces of important research undertaken in the laboratory was a verification of Ohm's law by Chrystal. The experiments of previous observers and Weber's theories had thrown doubt on its validity, but Chrystal showed that the law held with great accuracy over a wide range, and he was able also to explain the apparent discrepancies observed by others. Maxwell himself during his tenure of the professorship was mainly occupied in superintending the work of others, in preparing for the press his celebrated treatise on electricity and magnetism, his treatise on heat, and in the editing of the Cavendish papers. The "small book on a great subject" entitled "Matter and Motion" was also published during the same period. The greater portion of his energies during the closing years of his life was devoted to the editing of the electrical researches of the Hon. Henry Cavendish, F.R.S., great uncle of the Duke of Devonshire, the founder of the laboratory. Cavendish, at his death, had left behind a mass of unpublished manuscript containing an account of his electrical researches. An examination of these papers showed that Cavendish was far in advance of his time in knowledge of electricity, and had made many important discoveries.

Although Maxwell did not find time to do very much experimental research in the Cavendish, his influence in directing the work of others and in infusing fresh life into the mathematical studies at Cambridge cannot be overestimated. In the "Life of Maxwell," Lord Kelvin, writing in 1882, gives the following important testimony:—"The influences of Maxwell at Cambridge had undoubtedly a great effect in directing mathematical studies into more fruitful channels than those in which they had been running for many years. His published scientific papers and books, his action as examiner at Cambridge, and his professorial lectures, all contributed to this effect; but, above all, his work in planning and carrying out the arrangements of the Cavendish Laboratory. There is, indeed, nothing short of a revival of physical science at Cambridge within the last fifteen years, and this is largely due to Maxwell's influence."

Maxwell's reputation, although great during his lifetime, has continued to grow steadily since his death. His work on the kinetic theory of gases, on dynamical subjects, and on the theory of colours was sufficient to place him in the very first rank of scientific investigators, but it is on his great work in electromagnetic theory that his fame will ultimately mainly rest. Maxwell's views of the electromagnetic field and his electromagnetic theory of light were generally accepted among English physicists, but on the Continent, where rival theories held the field, were practically unknown except to a few. The brilliant experiments of Hertz and others on the production and properties of electrical waves verified in a most conclusive manner Maxwell's theory that light was an electrical disturbance in the luminiferous ether. This gave a great impetus to the study of Maxwell's theory of the electromagnetic field, and it is safe to say that practically all the mathematical theory of the last

fifteen years on the subject has been based on Maxwell's fundamental equations, and is largely a result of his theoretical views.

On Maxwell's death (1879) Lord Rayleigh was appointed, and held the chair until 1884, when he resigned to take the place in the Royal Institution vacated by the retirement of Tyndall. His short tenure of the Cambridge chair was marked by a series of classical researches in the Cavendish Laboratory on the value of the electrical units. Lord Rayleigh undertook a determination of the three fundamental units, the ohm, the volt, and the ampere, and performed this work with an accuracy that has left little room for improvement. It is hardly necessary to speak here of his valuable work in this connection, which is so well known to every physicist, but it suffices to recall his experiments on the ohm with a modified form of the British Association revolving coil, his determination of the electrochemical equivalent of silver and the E.M.F. of the Clark cell by means of his current balance, and his determination with Mrs. Sidgwick of the specific resistance of mercury. At the same time he determined in absolute measure the rotation of the plane of polarised light of carbon bisulphide in a magnetic field. In addition to this electrical work, a number of optical papers of great value were written within this period. We have confined our attention to the work of Lord Rayleigh in the Cavendish Laboratory. To the great mass of valuable work produced before and after his stay in Cambridge (now collected and published in four large volumes) it is impossible even to refer in this short article.

On the resignation of Lord Rayleigh, J. J. Thomson was appointed, at the early age of twenty-six. Like his predecessors in the chair, Prof. Thomson is a product of the mathematical and physical school of Cambridge, first taking the mathematical tripos and then entering upon experimental work in the Cavendish Laboratory. His first piece of work, undertaken before his appointment, was a determination of "v"—that important ratio between the electromagnetic and electrostatic units to which so much attention was devoted before the verification of Maxwell's electromagnetic theory. This was followed by a notable piece of mathematical analysis dealing with the action of vortex rings on one another, which gained for him the Adams prize. In this paper he investigated with great mathematical power the stability of interlocked vortex rings, and showed that not more than seven could be linked together without breaking up into new arrangements—a result which probably indicates the reason why no element has a greater valency than seven. In this work we have the first evidence of the bent of J. J. Thomson's mind towards the study of the constitution of matter—a study to which he has devoted so much attention with such conspicuous success in recent years. Next followed the publication of a book on the application of dynamics to physics and chemistry—a notable work in which a general method of analysis, based on Lagrange's equations, was used to solve many recondite physical and chemical problems. Among these may be mentioned an investigation of the action of an electrified atom in causing the condensation of water vapour around it. This result has proved to be of great importance in connection with later work to be done in the laboratory.

The year 1887 saw the publication of a paper on the effect of a moving electrified sphere, not only remarkable for the direct results obtained, but for its indirect bearing on the question of the origin of mass. The results of a mathematical analysis showed that a moving charge of electricity possessed an apparent or electrical mass in virtue of its motion. This electrical mass was constant for slow speeds, but increased with great rapidity as the speed of light was approached until, at the velocity of light, it became infinite in value. The possibility that mass, which has been such a mystery to science, is due to electricity in motion has been recently brought much into evidence by the experiments of Kaufmann on the kathodic rays of radium. He has shown that the apparent mass of the particles constituting the kathode rays, spontaneously emitted by radium, increased with the speed in accordance with the theory first advanced by J. J. Thomson, and afterwards developed by Heaviside, Searle and Abraham. This result points to the possibility that the apparent mass of the kathodic ray particle may be accounted for by electricity in motion without the necessity of any material nucleus.

The following years were occupied partly with investigations on the electrodeless discharge, the electrification produced by falling drops of water and experiments on electrical oscillations, and also with the preparation for the press of a text-book on electricity and magnetism, and a splendid volume entitled "Recent Researches in Electricity and Magnetism." These two books are so well known to every physicist that no further mention is necessary here.

J. J. Thomson next definitely attacked the problem of the nature of the discharge of electricity through gases. A repetition of Perrot's experiments on the passage of electricity through steam and experiments in vacuum tubes led him to the view that, as in a solution, the passage of electricity through gases was accompanied by electrolysis. This theory has been modified with the growth of experimental knowledge to the view that the discharge in gases is due to the motion of charged carriers or ions. These ions are not necessarily identical with the corresponding ions in the electrolysis of solutions. There is no doubt that there is in many cases an actual electrolysis similar to solutions occurring in gases, but this seems to be the result of a secondary action.

A great impetus was given to the study of this subject by the discovery of Röntgen rays. These rays possess the power of making all gases temporary conductors of electricity. In a paper with Rutherford, J. J. Thomson advanced the view that the conductivity imparted to the gas by the rays was due to the production of positively and negatively charged ions in the gas. These ions travel in an electric field with a velocity proportional to the strength of the field. When no electric field is acting the ions gradually disappear by recombination amongst themselves. This theory was found to explain all the characteristic properties of the conducting gas. In the course of the next few years, as a result of the joint efforts of those engaged in research in the Cavendish Laboratory—among whom may be mentioned C. T. R. Wilson, Maclelland, Rutherford, Zeleny, Townsend, Langevin, H. A. Wilson, Maclennan and Strutt, and many more besides—the subject developed with great rapidity along two distinct lines. By purely electrical methods the ionisation theory of gases was shown to account for the conductivity of flames and vapours, the discharge due to ultra-violet light and to radio-active substances. At the same time the admirable experiments of C. T. R. Wilson on the detection of ions by means of their power of becoming centres for the condensation of water vapour upon them showed that charged ions actually did exist distributed throughout the gas, and were not a figment of the imagination.

During this time J. J. Thomson published a remarkable paper on the nature of the kathode rays. Since their discovery by Crookes, the nature of these rays had been the subject of what may almost be called an international controversy. The English school took the view that they consisted of a stream of matter projected with great velocity; the German school regarded them as a kind of wave motion in the ether.

The experiments of Crookes had shown they were deflected by a magnet, while Perrin much later showed that they carried with them a negative charge. If the rays consisted of negatively charged particles, they should be deviated by their passage through an electric field. Hertz had tried such an experiment, but with negative results. The remarkable experiments of Lenard and the connection in some way between Röntgen and kathode rays made the elucidation of the true nature of these rays a matter of the first importance. It was at this stage that J. J. Thomson attacked the problem. He showed that the rays were deviated by an electric field, and explained the cause of the failure of Hertz to detect the same. By two distinct methods he proved that the rays consisted of negatively charged particles projected with a velocity of about one-tenth the velocity of light. The value of the glowing carbon filament of an incandescent lamp, had the same value of e/m as the corpuscle in the vacuum tube. These results indicated that the corpuscle, or electron as it is sometimes called, was the protyle or fundamental unit of which matter is built up. He suggested that the atoms of matter were very complex systems, consisting of a great number of corpuscles and corresponding positively charged bodies. It is remarkable that corpuscles only carry with them a negative charge. The positive charge appears always to be associated with matter atomic in size.

This work was followed by a series of investigations in the laboratory on that most complicated of all types of discharge—the passage of electricity through a vacuum tube. Anyone who has witnessed the gradual exhaustion of a vacuum tube from atmospheric pressure to the lowest vacuum cannot fail to have been

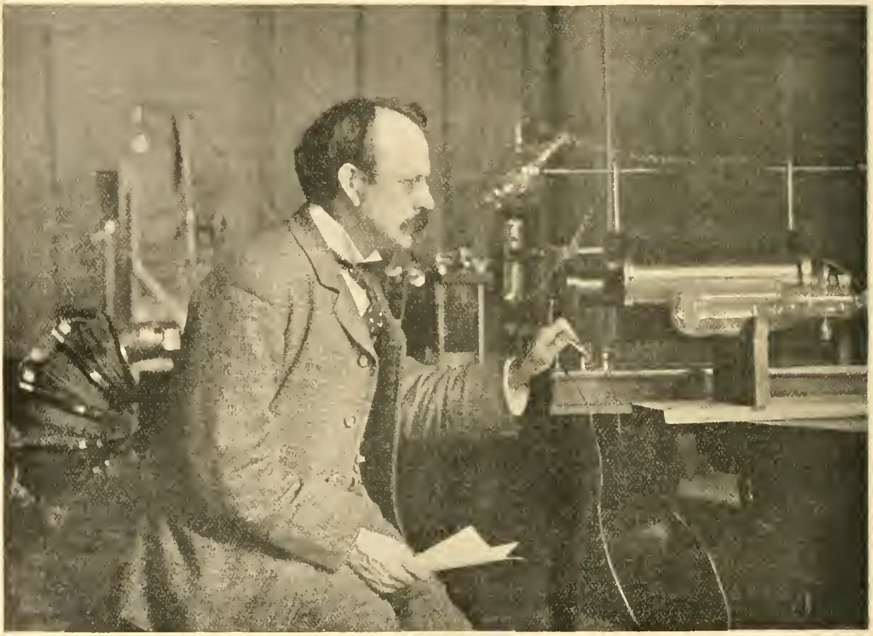


FIG. 1.—Prof. J. J. Thomson in the Laboratory.

e/m, the ratio of the charge on the particle to its mass, was about 1000 times greater than the value of e/m for the hydrogen atom in the electrolysis of water. If the charge is the same for both, this shows that the mass of the kathode ray particle, or corpuscle as it was termed, is only about 1/1000 of the mass of the hydrogen atom. The great penetrating power of the corpuscles and the law of their absorption in matter all supported the idea that the corpuscle was small compared with the molecules of matter. The value of e/m of the corpuscle was found to be independent of the gas in the vacuum tube.

A series of experiments was then undertaken which led to very remarkable results. J. J. Thomson found that the negatively charged particles, released by the action of ultra-violet light on a zinc surface, and from

struck with the variety and complexity of the phenomena displayed by the electric discharge through it. While much work still remains to be done, it may safely be said that the main phenomena are now fairly well understood, and can be satisfactorily explained on the ionisation theory of gases.

In addition to this work on the passage of electricity through gases, J. J. Thomson has also attacked the allied problem of the passage of electricity through metals. A theoretical paper on this subject was contributed by him to the International Scientific Congress at Paris in 1900, in which the negatively charged corpuscles in the metal were considered to be the chief factors in the transmission of electricity. Two possible experimental methods of attack on the question were suggested—the effect of a transverse mag-

netic field on the resistance, and the increase in specific resistance of very thin films. Mr. Patterson, working in the Cavendish Laboratory, has followed out these lines of attack with considerable success. The results obtained were in agreement with the predictions of the theory. While we must await the result of other lines of research for a further knowledge of this important question, a very promising beginning has already been made.

The great mass of work published during the last seven years by J. J. Thomson and those working under him in the Cavendish Laboratory has enormously increased our knowledge of the nature of the electric discharge, and has worked a veritable revolution in ideas of the constitution of matter. When sufficient time has elapsed for the importance of this work, and of the consequences that follow from it, to be more accurately estimated, it is not too much to say that it will be recognised as marking an epoch in the history of physical science.

It is now necessary to speak of a movement for the promotion of research that has been fraught with important consequences to the Cavendish Laboratory and to Cambridge University in general. In 1895 the Universities of Oxford, Cambridge, Edinburgh, and Glasgow arranged to admit graduates from other universities to a course of post-graduate study without any examination or restrictions. These advanced students are allowed at once the position and privileges of the Bachelor of Arts of the university. If the advanced student devotes himself entirely to research under some recognised teacher, he may obtain the degree of B.A. without examination after two years' work, provided the results of the investigation submitted are "of distinction as a record of original research." In practice the standard of this research degree is equivalent to that of the degree of Doctor of Science in most other universities. The result of this wise legislation was at once made manifest. Large numbers of advanced students, not only from the universities of Great Britain, but also from her colonies, from America, and from the Continent, have come to Cambridge to take advantage of her unequalled facilities for advanced work and research. In no department has this influx of advanced students been more numerous or its influence more strongly felt than in the Cavendish Laboratory. Attracted by the genius of the professor, those anxious to pursue research in physical science have come from all parts of the world. The numbers were small at first, but have steadily increased until this year nearly thirty young men have been engaged in research in the Cavendish Laboratory alone. The gathering is a thoroughly cosmopolitan one. Here we find working together graduates not only of most of the universities in Great Britain, but also from Canada and Australasia, from the United States of America, with an occasional representative from France, Germany, and Austria. The mutual influence of such a number of young investigators, each engaged in the pursuit of science for its own sake, cannot be too highly estimated. Unlike some foreign laboratories, there is a thorough freemasonry among the workers in Cambridge. Beside his own research, a student is acquainted with that of twenty others working beside him. He knows their difficulties and the methods of overcoming them, and at the same time is able to see within a short period the cumulative effect of their labours.

The influence towards research exerted by Prof. Thomson on all those who have worked under him is no evanescent one, for his students continue to do good original work and to foster the spirit of investigation, whether they reside in Great Britain or in her colonies. As a sign of their appreciation of the services of J. J. Thomson, the past and present workers in the laboratory have had painted an excellent portrait of the professor, which has just been hung in the laboratory.

The amount of work involved in the superintendence of the researches of so many students is necessarily very great, yet this is undertaken by Prof. Thomson with the utmost willingness and individual interest. Every morning the professor goes the round of the laboratory and inquires of each student the progress of his work. When difficulties arise he is always ready to give the student the benefit of his knowledge and experience, and to make valuable suggestions for future work. In the afternoon there is a social gathering for tea in the professor's room, where he is always ready to discuss scientific matters or to enjoy the latest joke.

Few men are capable of working so steadily and at such high pressure as Prof. Thomson. Besides superintending the teaching and research work of the laboratory and delivering courses of advanced lectures, he is continuously engaged in scientific investigation.

In the preparation of his experiments he is assisted by Mr. Everett, whose skill in glass blowing and manipulation is always kindly placed at the disposal of the laboratory. In addition to a great amount of experimental work, Prof. Thomson, in conjunction with Prof. Poynting, has found time to publish a series of valuable text-books. Two works on sound and properties of matter have already appeared, and a third is in the course of preparation. At the same time, a volume on the discharge of electricity through gases has lately been published. Much of the work has been done by Prof. Thomson and his students in the Cavendish Laboratory, and an account of this important subject is awaited with much interest by physicists.

Prof. Thomson has not confined his energies to England, but has, during his Cambridge vacations, twice visited the United States of America by invitation to deliver courses of lectures. In the first visit he gave a course of lectures at Princeton University which has been published in book form. In his second visit this year, he gave courses of lectures at both Yale and Johns Hopkins Universities. The American physicists are second to none in their admiration of the work done by Prof. Thomson, and his lectures have been attended in great numbers by physicists from all parts of the States. Anyone who has been in America must have been struck by the deep impression created by these lectures.

The large amount of research carried on in the laboratory has not been allowed to interfere to an undue extent with the regular teaching and practical courses. The Cavendish Laboratory was one of the first to appreciate the great importance of practical work in the teaching of science. The excellent laboratory courses now provided for all classes of students are to a large extent due to the labours of Glazebrook, Shaw, Newall, Fitzpatrick, Wilberforce, Skinner, and Searle.

Mr. Fitzpatrick and Mr. Skinner have organised an elementary practical course of instruction for the medical students, while Mr. Searle has devised an admirable course of physical experiments for students taking the first part of the science tripos. The advanced course of practical instruction is at present supervised by Mr. C. T. R. Wilson.

The amount of apparatus required for such a large number of students engaged in research has naturally proved a severe drain on the resources of the laboratory. As in many other scientific laboratories in England, the funds for improving the equipment have been limited. The University of Cambridge has always been liberal in the support of science, but in the present state of the university funds the money to

be allotted to any one laboratory is of necessity small. The Cavendish Laboratory in the past has done most excellent work in somewhat difficult circumstances, but at the present time there is a crying necessity for both increase of space and equipment to carry on the work of the laboratory under the best conditions. Splendidly equipped laboratories are now springing up in all parts of the world, and it is a matter of regret that funds should not be available for the extension and further equipment of the Cavendish Laboratory to keep pace with the times. Under Prof. Thomson, the laboratory has done splendid work in the past, and will continue to do splendid work in the future, but more and better work would be done if greater space and more apparatus were available. An additional sum of 20,000*l.* spent on the laboratory would greatly increase its efficiency, and it would be difficult to find an investment for such a sum which would be productive of such great returns to the cause of science and indirectly to the welfare of the race.

GREAT BENIN.[1]

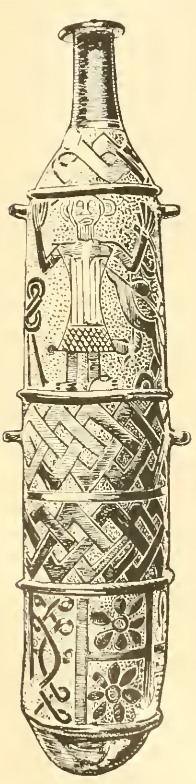


FIG. 1.—Engraved brass bottle, Height 16 in. British Museum. From "Great Benin," by H. Ling Roth.

THOSE who are acquainted with Mr. Roth's earlier meritorious books, "The Tasmanians" and "The Natives of Sarawak and British North Borneo," will know what to expect in a new work by that enthusiastic and indefatigable student. One is impressed with Mr. Roth's evident intention to be quite fair, and to present to his readers all the available data, but the literal quotations from various authors lead to inevitable repetition and occasional contradiction. As in his book on Borneo, Mr. Roth has been at great pains in collecting from scattered sources very numerous interesting illustrations, which materially enhance the value of the book. Mr. Roth appears to have a predilection for issuing limited editions of his books, and we are informed that "the number of copies of this work is limited to 320, and no other or cheaper edition will be issued."

The permanent fame of Benin will rest not on the butcheries of slaves and other unfortunates which shocked the civilised world, but on the skill displayed by the native artists in wood and ivory carving, and more especially by the artificers in bronze and brass. The first castings that came to Europe revealed an unsuspected mastery of technique, and despite the publication of several papers and a couple of memoirs by various students, there is yet more to learn concerning the significance of the very varied subjects represented. Mr. Roth takes a view that differs from that supported by most previous writers; he believes that the art existed in Benin prior to the advent of the Portuguese at the end of the fifteenth century, and that it was just emerging from the stage of realistic representations and beginning to make an attempt in the direction of decoration. As was the case with many other things with which the Portuguese came in contact, these remarkable explorers left their mark strongly impressed on this art work, and thus the natives began that series of borrowed forms which is so mixed up with native motives; perhaps Mr. Roth is somewhat too prone to see exotic designs in Benin art work.

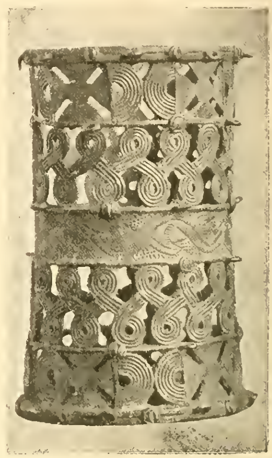


FIG. 2.—Brass armlet, 5¾ in. high In Mr. R. K. Granville's collection. From "Great Benin," by H. Ling Roth.

We reproduce in the first figure a brass bottle with very characteristic interlaced patterns, which are evidently derived from leather-work. The brass armlet or leglet in the second figure has some typical ornamentation; it is said these long armlets or leglets are put on when the individual is quite young, and not taken off until death, if then; in the event of removal, the foot or hand has frequently to be chopped off first.

With so much to choose from, it is difficult to indicate what the book contains; the sociologist will find what is known concerning domestic life, court life, government, trade and industries; the ethnographer is informed about weapons, games, buildings, and what the people do and make.

Mr. Roth's object has been to gather together all he could discover about Benin, and, besides earlier publications, he has drawn largely upon Mr. Cyril Punch, an excellent observer who in addition has furnished Mr. Roth with sketches and interesting photographs. Fresh information has also been given by the author's brother, Dr. Felix N. Roth.

Owing to the number of authors cited, added to the fact that none of them made anything like a study of the people, the information garnered by Mr. Roth is very fragmentary, but the author is not to blame for this, and the book will have further increased its usefulness if it indicates how imperfect our knowledge is, and leads to a more detailed and thorough study of the people. It will, however, always remain a valuable work for students, as references are given with fulness, and it is embellished with a large number of excellent illustrations

[1] "Great Benin, its Customs, Art and Horrors." By H. Ling Roth. Pp. xxxii+234 with 275 illustrations. (Halifax: F. King and Sons, Ltd., 1903.)

THE SURVEY FORMATION-MONOGRAPHS.[1]

Besides the descriptions of districts and the explanations of the published maps and sections, the Geological Survey has of late years issued treatises upon separate formations. In these a full description is given of certain geological horizons the survey of which has been completed or so nearly finished that there is no probability of any important change of classification being called for. The subject is exhaustively treated, the palæontological and petrological characteristics of the group are described, and its relation to the equivalent geological deposits on the Continent discussed. The work before us is the second of three volumes on the Cretaceous rocks. The first volume dealt with the Lower Cretaceous, the second, which has just been published, being devoted to the Lower and Middle Chalk, and the third, which it is hoped will be published this year, completing the monograph with a description of the Upper Chalk, the discussion of some postponed economical and geographical questions, and the full list of Chalk fossils.

The authors are of opinion that none of the lithological names hitherto applied to portions of the Lower Chalk can be used without confusion or inconsistency, and find themselves compelled to seek a more satisfactory method of subdivision in the limitation of the range of certain species of fossils. Nor do they seem to regard with much more favour the use of names derived from localities. We must be careful, however, in the advance towards fuller knowledge of details not to sacrifice precision to consistency. A locality can always be found, and when we get there we can generally see what an author meant. Fossils are not always forthcoming, and from the nature of the case frequently turn up where not found before. Moreover, the names of fossils are being too often changed. Palæontology, in its present phase, is a very useful handmaid in geological classification, but a very exacting mistress in nomenclature. The zone of *Terebratulina gracilis*, for instance, is so called after a form of doubtful determination, unsettled name, and inconstant occurrence.

It is interesting to follow the authors when they point out and explain the changes in the Cretaceous rocks as they trace them from one area to another. In the south-west, coarse sand and grit take the place of chalk, and suggest that we are getting near the shore of the Cretaceous sea, and that newer beds crept over the older deposits which are seen at the base further east, where the land went down first. So Barrois has observed that certain beds in the north-east of France thin out as they approach the Palæozoic ridge, while the Lower Chalk in the south-west is represented, as in the Sarthe, by sands and sandstones. Chemical and mineralogical examination tells the same tale. The fine mud, which in Wilts furnishes 16 per cent. of the material, increases in the deposits of the same horizon as we trace them to the N. and N.E. to 28 or 41 per cent. Minerals which are well known constituents of the granitic rocks of the south-western counties occur in the Lower Chalk of the far south-west, but have not been found in the corresponding beds of the midlands.

Many interesting subjects for investigation are suggested by an examination of the Cretaceous series. The replacement of portions of the chalk by flint might at first seem to require only depression to such a depth that the temperature of the included water would be sufficiently raised to carry silica in solution, while the pressure was so great that the chalk-dissolving acids would be retained in it. But there are other factors of which we must take account. The arresting or retarding of the percolating water had something to do with it, as may be inferred from the manner of occurrence of tuberous and tabular flint along the bedding and joints, and the limitation of flint over large areas to certain horizons so constantly that their abundance or absence was long taken as a sufficient indication of the horizon. So also the supply of silica from spicules in the upper part, or the presence of much siliceous sand in the lower part, must be taken into consideration.

Phosphatic nodules, which occur at widely separated horizons from the Bala Limestone to the Crag, are peculiarly variable in character and mode of occurrence in the Cretaceous series, and from their economic value and scientific interest call for discussion. Some of them are derivative from older beds, and the area from which they have drifted has been pretty clearly made out, but that only pushes the question into other associations; the difficulties remain. There is generally evidence of a change in conditions of deposit where they occur, but it does not often point to a stationary period when animal life was abundant and sedimentation slow, which appear to be the conditions required in explanation.

The name clunch is applied to any chalk which is used as a building stone, whether it is obtained from the firmer beds in the marl, or from the Totternhoe stone or even from higher horizons. Where the Totternhoe stone is accessible it is preferred. It has been largely used at Ely, Burwell, and elsewhere for internal decorative work, and if cared for has often lasted wonderfully, even where exposed to the action of the weather. Near Reach it has been quarried from Roman times, as proved by its having been used in the basement of the Roman villa found near the railway east of the village.

The Red Rock of Hunstanton, &c., does not find a place in this volume, because it was not considered to be part of the Lower Chalk, but was regarded as the representative of the gault, and was accordingly described in the previous volume. Other red beds, however, occurring at higher horizons in the chalk are duly noticed. The Lower Greensand, which is green in borings, is foxy-red or yellow at the outcrop. This is clearly due to the percolation of water from the escarpment. There is much to suggest that the Red Chalk of Hunstanton may have sucked up the colour by capillary attraction from the underlying Car-stone. The red colour does not, however, always coincide with bedding planes, and the irregular occurrence of red beds in the chalk described in this volume is not so easily explained.

The memoir is an able exposition of the results which have been arrived at by long and careful work concentrated upon certain definite geological horizons, but illustrated by wide observation and study. It well supports the prestige of these formation-monographs, from which a large and ever increasing public derives so much benefit.

[1] Memoirs of the Geological Survey of the United Kingdom. The Cretaceous Rocks of Britain. Vol. ii.—The Lower and Middle Chalk of England By A. J. Jukes-Browne, with contributions by Wm. Hill. Pp. xiii+568+plates. (London: H.M. Stationery Office, 1903.)

NOTES.

We regret to announce that Mr. Herbert Spencer died on Tuesday morning, at eighty-three years of age.

The death is announced of Prof. Proust, the French Inspector-General of Sanitary Services.

The ships *Morning* and *Terra Nova* left Hobart on December 6 to go to the relief of the *Discovery*, now in the Antarctic regions.

The Rev. T. R. R. Stebbing, F.R.S., has been elected zoological secretary, and a member of the council, of the Linnean Society in succession to Prof. G. B. Howes, F.R.S., who has had to retire on account of ill-health.

Prof. W. D. Halliburton, F.R.S., has been selected to give the Herter lectures in connection with the University of New York in the coming year, and he has chosen as his subject the biochemistry of muscle and nerve. The lectures will commence on January 4, 1904.

A service in memory of the late Sir Frederick Bramwell, Bart., F.R.S., was held at St. Margaret's Church, Westminster, on Friday last, December 4. The service was attended by a large congregation, which included representatives of the Royal Society, British Association, Institution of Civil Engineers, and many other scientific and technical bodies.

A Dalziel message states that, having successfully exchanged messages regularly between Berlin and Munich, a distance of about 500 miles, the German Wireless Telegraphy Company is about to endeavour to establish communication between Berlin and the Swedish coast near Stockholm, a distance of more than 650 miles. The company uses a combination of the Slaby-Arco and Siemens systems.

Mr. F. F. Francis, Queen's Road, Wimbledon, writes to record an instance of a snake being killed by a mouse. An ordinary grass snake which he had in confinement was given a mouse for food. The snake made several attempts to catch the mouse, but in every case missed. The next day the snake was found to be dead, and there was evidence that it had been attacked and killed by the mouse, which was alive and had eaten a part of the snake's body.

An open competitive examination for not fewer than twenty-four situations as assistant examiner in the Patent Office will be held by the Civil Service Commissioners in January next. The examination will commence on January 5, and forms of application for admission to it will probably be ready for issue in the course of a few days; they will be obtainable on request addressed by letter to the secretary, Civil Service Commission, Burlington Gardens, London, W.

The Aberdeen Line steamer *Sophocles* arrived at Plymouth on December 3 from Sydney after experiencing exceptional weather in the Bay of Biscay. It is reported that during a severe thunderstorm the ship was struck by lightning, and the mainmast was scorched and blackened. A few minutes later, it is said, a brilliant meteor burst in the vicinity of the liner. "The attention of the passengers was attracted by a rushing sound, and immediately afterwards they saw an object plunge into the sea, apparently a few yards distant, on the starboard side of the liner, throwing up the water with a great splash."

Prof. L. C. Miall, F.R.S., has been elected Fullerian professor of physiology at the Royal Institution. The following are among the lecture arrangements at the Institution before Easter:—A Christmas course of lectures (adapted to a juvenile auditory) on extinct animals, by Prof. Ray Lankester; Prof. L. C. Miall, six lectures on the development and transformations of animals; Dr. E. A. Wallis Budge, two lectures on the doctrine of heaven and hell in ancient Egypt, and the books of the underworld; Mr. G. R. M. Murray, three lectures on the flora of the ocean; Mr. A. D. Hall, three lectures on recent research in agriculture; Prof. H. L. Callendar, three lectures on electrical methods of measuring temperature; and six lectures by Lord Rayleigh on the life and works of Stokes. The Friday evening meetings will begin on January 15, when a discourse will be delivered by Lord Rayleigh on shadows; succeeding discourses will probably be given by the Rev. Walter Sidgreaves, Mr. D. G. Hogarth, Mr. H. Brereton Baker, Mr. Alexander Siemens, Prof. W. Stirling, Prof. F. T. Trouton, Prof. Dewar, and other gentlemen.

Mr. W. T. Gibson has been appointed curator of the station of the Marine Biological Association of the West of Scotland, and Mr. J. M'Kenzie has been appointed assistant curator. Mr. Gibson is an associate of the Royal College of Science in London, and received his scientific education there, and also at the University of Edinburgh. He has done marine field work at the Gatty Laboratory, St Andrews, and also at the laboratory of the Northumberland Sea Fisheries Committee at Cullercoats. Mr. M'Kenzie has for the last eight years been laboratory assistant in the zoology and geology departments of Marischal College, Aberdeen.

The International Sanitary Conference, which has been sitting in Paris since October 10, has just closed its proceedings. A modification has been introduced in the period of surveillance in cases of contact with plague; this is reduced from ten to five days. The new convention provides for the manner in which outbreaks of cholera or plague are to be intimated, and, generally speaking, provides for greater facilities for international commerce, while giving additional guarantees for public health. It is proposed that an international sanitary office shall be established in Paris.

In a lecture upon intra-cellular bacterial toxins, delivered at the Lister Institute by Dr. Allan Macfadyen, the method of mechanically grinding bacteria with the aid of liquid air was demonstrated. The lecturer pointed out that there were two classes of bacteria, one, of which diphtheria and tetanus were examples, excreting, as it were, soluble poisons or toxins into the culture medium, the other producing no extra-cellular poisons, and in which the toxins seem to be associated with the bacterial cells, as is the case with tubercle, typhoid, cholera, plague, and a number of others. By disintegrating the cells of the last-named class, the intra-cellular toxins are set free, and on injection into animals produce toxic effects. By cautious injection with these intra-cellular toxins, the blood of the treated animal acquires antitoxic properties, and it is hoped that it may be possible by this means to obtain antitoxic sera for such diseases as typhoid fever and plague, similar to those now employed for diphtheria and tetanus.

Sir Patrick Manson, F.R.S., delivered an address on Monday afternoon at the London School of Tropical Medicine on the work of the school, the occasion being the departure of Sir Francis Lovell, the dean, for the East on behalf of the school. Sir Patrick Manson, having traced the history of the foundation of the school, paid a tribute to the late Colonial Secretary, who has done so much to forward the study of tropical medicine. With regard to the work of the school, it naturally came under two headings—education and research. Since the school was opened in October, 1899, no less than 354 students had passed through its portals. Research had been prosecuted so far as the limited means at their disposal had permitted. Dr. Low had shown that the filaria was introduced into the body by a mosquito, Drs. Low and Sambon had carried out an important experiment to prove the mosquito-malaria theory, Dr. Forde, a pupil of the school, had discovered a trypanosome in man, and Dr. Castellani had observed a trypanosome in sleeping sickness. Through the generosity

of Sir John Craggs a travelling scholarship of 300*l*. a year had been bestowed for three years, and the same donor now gave a valuable prize annually for the best piece of research work carried out by a pupil of the school. The need for further funds was emphasised if the work of the school was to be successful in the future. Sir F. Lovell in a previous mission to the East had collected a considerable sum of money, 100,000 rupees being contributed by the Hon. B. Petit, of Bombay.

The suggestions made by Sir Oliver Lodge at the Physical Society on November 13 (see p. 94) as to the possibility of dissipating fog by discharge of electricity into the air have attracted much attention. Experiments proving how a smoke-filled chamber could be cleared by the discharge were shown by Sir Oliver Lodge twenty years ago, and have been repeated by many lecturers since then, but no installation on a large scale was established. In reply to a correspondent who has asked whether street arc lamps could be utilised for the purpose, Sir Oliver Lodge says, "Your suggestion seems a practical one, and it would be a very good thing if something of that kind could be done. The difficulty is the insulation. If that could be guaranteed, the matter would be comparatively easy; but the potential is extremely high—say 100,000 volts. The quantity is next to nothing, and very little power is sufficient if only one could avoid leakage. I can tell you the kind of insulators that we employed for the single mast that I used in Liverpool, but it is a very different thing to try to distribute it over a number of street lamps. It is a matter very well worth consideration, however, and I am glad to find that your attention is called to the matter. In the Liverpool experiment I was using a potential higher than 100,000 volts; one could take sparks 4 inches long. But a good deal smaller voltage would do if there are walls or other earthed surfaces in the neighbourhood. For a lofty isolated mast the potential must be higher in order to secure adequate discharge."

At the meeting of the Institution of Civil Engineers on November 24, Dr. H. R. Mill read an interesting paper on the distribution of mean and extreme annual rainfall over the British Isles. The results, which were exhibited by isohyetal lines, or lines of equal rainfall, were based on the means of thirty years, 1870 to 1899, and showed that a mean annual fall under 25 inches occurs in three places:—(1) a very narrow strip round the Moray Firth; (2) a triangular area about the Thames estuary; and (3) a large portion of east central England south of the Humber; and that the amount increases in various districts, in which altitude and configuration of the land form important features, to 40 inches and upwards. Falls of more than 100 inches are found:—(1) in the lake district, around Seathwaite; (2) in the western Highlands; and (3) in the Snowdon district. The average rainfall, to the nearest half-inch, for each country is given as follows:—England 31·5, Wales 49·5, Scotland 47·0, Ireland 42·0 inches, and for the whole of the British Isles 39·5 inches. The extremes of annual rainfall were discussed by taking out the figures for the driest and wettest year of the thirty years' period. The excess of rainfall in 1872 was stated to be 34 per cent., and the deficiency in 1887 23 per cent. of the average fall for the British Isles as a whole. The average rainfall over the whole of the British Isles for these two years was:—in 1872 53 inches, and in 1887 30·5 inches.

We have received a prospectus of a new fortnightly meteorological bulletin, entitled *La Previsione del Tempo*, to be published in Rome on the 1st and 16th of each month, under the superintendence of Father A. Rodriguez. The bulletin will consist of eight large octavo pages, four of which will be occupied by diagrams exhibiting the principal meteorological data, and will form the basis for the calculation of the proposed predictions. These data will refer to some of the chief places in Europe (including Ireland), Algeria, and Tunis, for each of which forecasts are to be drawn. The remaining four pages will consist of text, and will contain a brief summary of the atmospheric changes of the preceding period, forecasts for the succeeding period, meteorological notes, and the fundamental principles of the system of prediction employed. The author has set himself a difficult, and we fear an impracticable, task, but as he apparently proposes to proceed upon strictly scientific lines, we shall be interested to learn what amount of success he may obtain. For this country at least, the changes from one type of weather to another appear to be too sudden to allow of a tolerably safe forecast for more than a day or two in advance, nor has more been yet attempted by any of the European central meteorological offices. The author, however, appears to be sanguine of obtaining a success of 65 to 75 per cent.

In the Meteorological Office pilot chart for December the attention of mariners is directed, in a lengthy description of the Aurora Borealis, to the question of more careful and systematic observations of the various phases of auroræ. They are asked to supply details as to the following points, to which scientific inquiry might be directed:—The angle which the apex of the arch makes with the horizon; the orientation of the arch or arches; the lateral motion of the streamers, whether from right to left or left to right: does the individual streamer move sideways, or do fresh streamers arise to one side of the former? As a rule, streamers are parallel to the dipping needle—it should be noted if any streamers are curved. Can stars be seen immediately under the base of streamers? It should be noticed if the arches always move from north (magnetic) to south, and, if so, whether it is by a motion southward of the individual streamers or by new streamers appearing to the south of the old ones; the formation of coronæ by streamers should be carefully watched and noted, and special notice should be taken of the behaviour of the compass when an aurora presents the appearance of a luminous curtain.

A short account of the meeting of the Deutsche Gesellschaft für Mechanik und Optik which took place at Ilmenau on August 14 and 15 is given by Prof. L. Ambronn in the *Physikalische Zeitschrift* for November 15.

The *Verhandlungen* of the Deutschen zoologischen Gesellschaft for the present year contains the papers read at the session held in Würzburg on June 2–4. In the obituary notices reference is made to the loss sustained by zoological science in the death of Prof. G. Radde, of Tiflis. The papers, which are for the most part short, cover a wide range of subjects, but there are none among them which call for special notice.

We have received a copy of Prof. W. B. Benham's presidential address to the biological section of the Australian Association. The subject is the geographical distribution of earth-worms and the palæography of the Antarctic region. In the first place, from their invariable association with angiospermous plants, the author is of opinion that earth-worms form a comparatively modern group, which did not attain any important development before the Cretaceous. The ancestral type would appear to have been more or less nearly related to the existing Notiodrilus, of which the headquarters, if not the birthplace, was the "Melanesian plateau." New Zealand and the neighbour-

ing islands, which possess the most ancient worm-fauna, were separated at an early date from this plateau. From this area the primitive worms travelled in one direction into the Austro-Malayan countries, while in another, by way of Antarctica, they reached South America and Africa. Other theories as to former land-connections in the southern hemisphere are propounded.

In the *Transactions* of the South African Philosophical Society Dr. Bolas and Major Wolley-Dod have published a list of the flowering plants and ferns of the Cape Peninsula, and have thereby brought to notice a flora which presents a number of unique features. In the first place, from an area of rather less than 200 square miles, they report more than 2000 flowering plants, and amongst these there are a number of representatives of such uncommon orders as Selaginaceæ, Restiaceæ, and Proteaceæ. Another striking character is the richness in species of several genera; thus Erica possesses no fewer than 92 species, Mesembryanthemum shows 61, while the very rare genus Restio has as many as 29 representatives.

Much uncertainty has existed as to whether or no the bacterial cell possesses a nucleus. Some have considered that it does not, others that it contains a fragmented one, or one of the ordinary type, or that the whole cell is a naked nucleus. Profs. Rayman and Kruis (*Bulletin* Acad. des Sciences de l'Empereur François Joseph I., June 5) claim to have shown by a special staining method that a nucleus is present in the form of a small round body situated at about the centre of the cell. In order to demonstrate this structure, films are prepared on perfectly clean cover glasses, dried in a desiccator, treated with a mordant of iron-alum, and stained with a dye known as alizarine PS, or its constituents. The paper is illustrated with some excellent reproductions of photographs.

We have received the *Transactions* of the Leicester Literary and Philosophical Society for the session 1902–3. The volume also contains the report of the council and the annual reports of the sections into which the Society is divided for working purposes. Numerous papers are reprinted, and some of them are well illustrated. The volume is published at sixpence by Messrs. Thornley and Waddington, of Leicester.

A third edition of Prof. James Walker's "Introduction to Physical Chemistry" has been published by Messrs. Macmillan and Co., Ltd. A new chapter on electromotive force has been added, and the chapter on thermodynamical proofs has been extended. In cases where recent researches have made it possible, more accurate numerical values and better illustrative examples have been substituted in the text.

The current number of the *Quarterly Journal* of the Royal Meteorological Society is an interesting one. Dr. W. N. Shaw, F.R.S., in a paper containing several instructive figures, gives a detailed analysis of the meteorological aspects of the storm of February 26–27. Mr. C. P. Hooker discusses the relation of the rainfall to the depth of water in a well; Mr. W. Marriott examines the available observations in connection with the frost of April, and Mr. J. Baxendell gives illustrated descriptions of the Dines-Baxendell anemograph and the dial-pattern non-oscillating pressure-plate anemometer.

It is now the common practice to illustrate lectures and demonstrations in most schools and colleges by means of the lantern and lantern-slides. Those teachers and lecturers who have not mastered the art of making their own slides would do well to study the lists of slides which are to be purchased from Messrs. Newton and Co., of Fleet Street, London. We have received from this firm a supplementary list of slides to illustrate scientific and other subjects, and among them we notice sets dealing with the growth, structure, and defects of timber; the evolution of a frog; the bacteriology of tropical diseases; and the open-air cure for consumption.

A new illustrated catalogue of chemical apparatus recently published by Messrs. F. E. Becker and Co., of Hatton Wall, London, is one of the most complete and conveniently arranged that we have examined. Every item in the list is illustrated by a figure immediately adjoining it, and the unusually full index makes reference very easy. The catalogue gives information concerning all forms of chemical apparatus in general use in laboratories, and an exhaustive list of chemicals, reagents, and standard solutions is also included. Teachers of chemistry, and those who are engaged in chemical research, should obtain a copy of the catalogue to keep in their laboratories for reference.

A translation of a long thesis on radio-active substances, presented to the Faculté des Sciences de Paris by Mdme. S. Curie, is concluded in the current number of the *Chemical News* (December 4). The conclusions read as follows:—"I will define, in conclusion, the part I have personally taken in the researches upon radio-active bodies. I have investigated the radio-activity of uranium compounds. I have examined other bodies for the existence of radio-activity, and found the property to be possessed by thorium compounds. I have made clear the atomic character of the radio-activity of the compounds of uranium and thorium. I have conducted a research upon radio-active substances other than uranium and thorium. To this end I investigated a large number of substances by an accurate electrometric method, and I discovered that certain minerals possess activity which is not to be accounted for by their content of uranium and thorium. From this I concluded that these minerals must contain a radio-active body different from uranium and thorium, and more strongly radio-active than the latter metals. In conjunction with M. Curie, and subsequently with MM. Curie and Bémont, I was able to extract from pitch-blende two strongly radio-active bodies—polonium and radium. I have been continuously engaged upon the chemical examination and preparation of these substances. I effected the fractionations necessary to the concentration of radium, and I succeeded in isolating pure radium chloride. Concurrently with this work, I made several atomic weight determinations with a very small quantity of material, and was finally able to determine the atomic weight of radium with a very fair degree of accuracy. The work has proved *that radium is a new chemical element*. Thus the new method of investigating new chemical elements, established by M. Curie and myself, based upon radio-activity, is fully justified. I have investigated the law of absorption of polonium rays, and of the absorbable rays of radium, and have demonstrated that this law of absorption is peculiar and different from the known laws of other radiations. I have investigated the variation of activity of radium salts, the effect of solution and of heating, and the renewal of activity with time, after solution or after heating. In conjunction with M. Curie, I have examined different effects produced by the new radio-active substances (electric, photographic, fluorescent, luminous, colorations, &c.). In conjunction with M. Curie, I have established the

fact that radium gives rise to rays charged with negative electricity. Our researches upon the new radio-active bodies have given rise to a scientific movement, and have been the starting point of numerous researches in connection with new radio-active substances, and with the investigation of the radiation of the known radio-active bodies."

The additions to the Zoological Society's Gardens during the past week include two Black-eared Marmosets (*Hapale penicillata*) from South-east Brazil, presented by Mr. J. Arthur Turner; a Short-toed Eagle (*Circaëtus gallicus*) captured at sea, presented by Lieut. W. H. Colegrave, R.N.R.; four Chameleons (*Chamoeleon vulgaris*) from North Africa, presented by Mr. Thomas Yates; a Vervet Monkey (*Cercopithecus lalondii*) from South Africa, two Slender Loris (*Loris gracilis*) from Ceylon, a Blue-fronted Amazon (*Chrysotis aestiva*), a Rough-eyed Cayman (*Caiman sclerops*), five Black-pointed Teguexins (*Tupinambis nigropunctatus*) from South America, a Red-billed Toucan (*Ramphastos erythrorhynchus*) from Cayenne, two Red-handed Tamarins (*Midas rufimanus*) from Surinam, a One-bearded Greaved Tortoise (*Podicnemis unifilis*) from the Upper Amazons, deposited.

OUR ASTRONOMICAL COLUMN.

Observations of Solar Phenomena.—In a paper presented to the Paris Académie des Sciences, M. Deslandres discusses the various theories concerning the inter-relation of solar and magnetic phenomena which have been brought into prominence by the exceptional magnetic storm of October 31. He points out that, whereas the magnetic phenomena are recorded continuously at many widely separated observatories, the solar observations, which constitute the other side of the problem under discussion, are only made during short intervals each day and at fewer stations; therefore he strongly urges that solar observatories should be more widely disseminated in order that a *continuous* record may be obtained. Again, he points out that, at present, at least ninety-nine out of every hundred observers of the sun only record the *forms*, and not the *movements*, or velocities, of the solar disturbances, whereas in his opinion the records of the latter would prove much more effective in bringing us to a solution of the vexed questions.

M. Deslandres suggested in 1893, and in the present paper he strongly emphasises the fact, that it is essential, in order that our knowledge of solar disturbances may be rendered less defective, to obtain a *continuous* record of :—(1) The surface of the photosphere as photographed by the ordinary process; (2) the *forms* of the disturbances in the lower, mean, and higher chromosphere as obtained with the spectroheliograph; and (3) the radial velocities of these chromospheric disturbances as shown on photographs obtained with the spectroheliograph especially arranged to register these velocities. He states that the present instruments are perfect enough to ensure success, and estimates the annual expense of such observations (at Meudon) as twenty thousand francs (about 800*l.*) (*Comptes rendus*, No. 21, November 23).

The Spectrum of Lightning.—Mr. Phillip Fox, of the Yerkes Observatory, has recently succeeded in obtaining several spectra of lightning flashes which were taken with an objective-prism spectroscope consisting of a 30° flint glass prism mounted in front of a camera of 35 mm. aperture and 274 mm. focal length. Proceeding on the lines suggested by the visual observations of Vogel, Lohse, and Schuster, he compared his spectra with a spark spectrum of air obtained with the same instrument, and found that a striking agreement existed between the two.

Similar results were arrived at by Dr. W. J. S. Lockyer, who, in a recent number of the *Illustrated Scientific News* (No. 15, vol. ii.), described an extremely simple method whereby photographs of lightning flashes and their spectra can be obtained by using an ordinary camera having one of Thorpe's transmission gratings fixed in front of the lens. The spectra thus obtained by Dr. Lockyer in May of this year are shown to differ from those obtained by Prof. Pickering at Harvard in 1901, and a spectrum recently obtained by the latter is again different from either of the other two; all, however, bear a striking resemblance, in general appearance, to the air spark spectrum, the chief nitrogen lines being especially prominent.

In Mr. Fox's spectra it is seen that the various lines differ in intensity from one part of the flash to another, and, as this apparently indicates a variation of the spectrum with the atmospheric conditions, it seems probable that the differences existing between the several spectra may be thus explained.

Mr. Fox's article is illustrated by reproductions of the spectra obtained by him, and a comparison of the air and lightning spectra, and is published in No. 4, vol. xviii., of the *Astrophysical Journal*.

The Line Spectra of the Alkaline Metals.—In No. 27 of the *Physikalische Zeitschrift* Herren H. Konen and A. Hagenbach record the results of some observations made by them with the object of discovering additional lines in the secondary series of the spectra of lithium, potassium, cæsium, and rubidium.

In the spectrum of lithium four new lines were observed, but their diffuse character renders the determined wavelengths (6240·8, 4636·14, 4149·1, and 3934) rather untrustworthy, and for this reason it is difficult to determine finally whether they belong to a definite series or not, although it seems likely, from their character and their analogy to the lines in the sodium series, that they are really pairs, and belong to the first secondary series. No new lines were discovered in the potassium spectrum. In the spectrum of rubidium three new lines were discovered, and fourteen of the fifteen lines observed by Mr. Hugh Ramage in the flame spectrum were seen, although these observers were unable to find, either in the arc or the flame, the line at λ 5037 recorded by Mr. Ramage. These new lines fill up gaps in the first secondary series as calculated from Kayser and Runge's formula.

All the lines recorded by Mr. Ramage below λ 5750 in the cæsium spectrum were observed, together with an additional line at λ 5209.

PATAGONIAN "DIPROTODONT" MAMMALS.[1]

Señor Ameghino appears to be firmly convinced that the ancestors of a large number of groups of mammals are to be met with among the remains from the Santa Cruz and associated beds of Patagonia. Last year, in the journal quoted below, he attempted to prove the descent of the modern elephant, through Pyrotherium and certain other forms, from a primitive opossum (Proteodidelphys). Now he essays to demonstrate that the rodents have originated from another type of Patagonian "diprotodonts," namely, the Garzoniidæ, which is itself traced back to a still earlier group, the Microbiotheriidæ. Apart from zoological considerations, the possibility of such phylogenies depends entirely on the age assigned to the Santa Cruz and subjacent strata. If, with Dr. Ameghino, we regard them as of early Eocene, Cretaceous, and possibly Upper Jurassic age, then, from this point of view, there is nothing impossible in such pedigrees. If, on the other hand, we accept the view of the great majority of palæontologists that these strata are of Miocene age, the very foundations of Dr. Ameghino's elaborate phylogenies are at once destroyed.

Putting, however, this consideration on one side, we may refer briefly to some of the zoological features in the paper before us. Briefly stated, Dr. Ameghino's views, so far as we can follow them, appear to be as follows. In the Upper Jurassic of Patagonia there existed a primitive group of "diprotodonts" (that is to say, mammals furnished with a single pair of chisel-like incisors in the lower jaw), the Microbiotheriidæ. On the one hand, as we learn from the earlier paper, these gave rise to the Proboscidea, while on the other they culminated in the modern rodents, the diprotodont marsupials of Australia, and certain extinct forms,

[1] F. Ameghino, "Los Diprotodontes del ordren des los Plagiaulacoideos y el Origen de los Roedores y de los Polymastodontes" (*An. Mus. Nac. Buenos Aires*, vol. ix., pp. 81–192)

such as Plagiaulax of the Purbeck and Microlestes of the Trias (!). The author appears, indeed, to consider that, with the exception of Pyrotherium (which, despite its remarkable resemblance to Diprotodon, he places in the proboscidean line), all mammals with a diprotodont type of dentition are related to one another. And he endeavours to show that the dentition of one type passes by imperceptible degrees into that of another. But such gradations may be traced between the dentition of almost any groups, and no allowance whatever is made for parallelism in development, which has undoubtedly been an important factor in evolution. Moreover, no account whatever is taken of the undoubted resemblance existing between the cheek-teeth of the polymastodonts and the reptilian Tritylodon.

Then, again, according to the author's scheme, the true diprotodonts of Australia have no relationship with the polyprotodont marsupials of the same region, which is, on the face of it, an absurdity. It may also be pointed out that Dr. Ameghino takes no account of the work of other palæontologists. It is very generally accepted, for instance, that an intimate relationship exists between marsupials (as a whole) with the extinct creodonts, and so with the modern Carnivora (see Wortman, *Amer. J. Sci.*, vol. xiv., 144, 1902), while Prof. Osborn (*Bull. Amer. Mus.*, xvi. p. 203, 1902) has indicated the probability of the descent of the rodents from the Holarctic Eocene Mixodectidæ. Obviously both these phylogenies must be demonstrated false before there is even a *primâ facie* possibility for Dr. Ameghino's scheme. It will be interesting to learn what the United States palæontologists have to say on the subject when the groups in question come to be treated in the working out of the Hatcher collection. R. L.

GEOLOGICAL NOTES.

OBSERVATIONS have been made by Mr. R. D. Oldham on the growth of sandhills, which threaten to cut off communication between the town of Karachi and the suburb of Clifton, two or three miles distant (*Mem.* Geol. Surv. India, xxxiv., part iii.). He traces out the growth of dunes from small oval patches of sand which begin to accumulate on irregular tracts of the stony surface, pointing out that even a slight accumulation may cause an upward bend of the air currents whereby a space of comparative calm is produced, and sand more readily comes to rest. In course of time the oval patches of sand are heaped up with a sharper slope to leeward, down which the sand grains fall. Here a hollow is produced by an eddy of the wind, and this eddy serves to maintain and increase a crescentic form with a crater-like opening. The principal winds at Clifton blow from W.S.W., and form the main features in the sandhills; but winds from the E.N.E. blow during the winter months, causing a reverse slope and a bank of sand to be formed near the summit of the long gentle slope which faces the W.S.W. winds. There is a good deal of scour of the original steep leeward slope, but no complete reversal of the shape of the sandhill.

FIG. 1.—Sandhill near Clifton, Karachi, showing change of form and scour by wind.

Mr. Oldham points out that the original hollow is well shown in the accompanying view. The sandhill was first shaped by W.S.W. winds, then a period of E.N.E. winds caused a partial modification of form, heaping up the sand from that side and producing the steep slope facing to left of the picture. The sandhill was afterwards attacked by a S.W. wind, which commenced to reshape it, and this alteration at first led to the formation of notches in the crest, in which the wind became concentrated, leading to a violent scour and to the excavation of deep pits to leeward. The furthest of the notches has been cut down nearly to the foot of the steep slope. Eventually it and the other notches will be widened, and the intervening pinnacles will be lowered until the crest is reduced to a smoothly rounded outline. Mr. Oldham discusses the means which may be taken to arrest the progress of the sandhills, and concludes that much may be done by encouraging the growth of local grasses.

In an essay on the deformation of rocks, Mr. E. H. L. Schwarz (*Trans.* S. African Phil. Soc., xiv., part iv.) discusses their crushing strength, and remarks that this is less when the specimen tested is soaked in water. In natural circumstances in the earth's crust the crushing value of a column of rock, which would crush the layer at its foot, must be estimated by the weight of the material in water, and the author calculates that a column of sandstone must be from about two-thirds of a mile to five miles in height, one of granite from four to seven and a half miles, and one of felsite from seven to nine miles. The actual zone of mass deformation seems to be much nearer the surface, judging by the "creep" in mine-levels, and by the fact, in the case of deep bore-holes, that a cylinder of rock gradually rises from the bottom. The author alludes to the effect that crushing would produce along the bases of deep gorges, and he points out that the line of inquiry indicates that there must be a limit to the height of mountains and to the thickness of ice-sheets. He further discusses the deformation of rocks at great depths by the action of water.

In the *Proceedings* of the Royal Society of Victoria (n.s. vol. xvi. part i.), Mr. F. Chapman describes some new species of Silurian Polyzoa and Brachiopoda. Prof. J. W. Gregory discusses the formation of the Henty peneplain in N.W. Tasmania. In places it is 1300 feet or more above the sea, but is lower towards the north, west, and south. It appears to have been due to river-action in pre-Glacial times, when western Tasmania stood a few hundred feet lower than it does now. Its comparatively recent uplift is shown by the King River, which, east of Mount Lyell, flows through a very ancient flat-floored valley, and then traverses the peneplain in a sinuous narrow canyon.

An elaborate memoir on the Jurassic Trigoniæ of Cutch has been contributed by Dr. F. L. Kitchin to the *Memoirs* of the Geological Survey of India (Pal. Ind., ser. ix., vol. iii., part ii., No. 1). Most of the species of Trigonia have been obtained from the Putchum-Charee series, which, on the evidence of Cephalopoda, has been grouped with the European Bathonian, Callovian, and Oxfordian strata. In no case has Dr. Kitchin been able to identify any of the Cutch Trigoniæ with European species, but while they afford no definite evidence of the correlation above mentioned, they present no obstacles to its acceptance. They flourished in a different zoological province, but the Lower Charee (Callovian) forms bear the imprint of a facies which characterised a slightly earlier age in Europe, a fact suggestive of migration into the Cutch area. No Trigoniæ have been obtained from the Katrol (Kimeridgian) strata, but in the overlying Oomia beds, which appear to be transitional between Jurassic and Cretaceous, there are Trigoniæ that approximate in adult characters to forms found in the Uitenhage strata of South Africa. There is other evidence which suggests community between the Jura-Cretaceous faunas of the two areas, but as the forms in question differ widely in their youthful characters, Dr. Kitchin regards them as indicating homœomorphous derivation from separate stocks. Evolution of this character may have taken place under similar conditions, but it does not imply contemporaneity. The subject is of great im-

portance in the comparison of forms, in the naming of species, and in the correlation of strata by their aid. As the author points out, it demonstrates the necessity for abundant material in palæontological studies.

Mr. W. H. Dall has published a summary of the geological results of the study of the Tertiary fauna of Florida, 1886–1903 (*Trans.* Wagner Inst. Sci., Philad., iii., part vi.). He points out the objections to the method of grouping which was based by Lyell and Deshayes on the percentage of species that survive to the present day, as the conditions may be more favourable for the survival of species in one region than in another. The presence or absence of identical species in the Tertiary beds on either side of the Atlantic may be an important factor in correlation, but while this is partially true of older geological horizons, yet after the Mesozoic epoch the faunal characteristics of the shallow-water Mollusca of different regions became rapidly distinctive. Even in the Eocene but two or three species can be claimed as identical on both shores of the Atlantic, and in later periods it would be unreasonable to expect to find a series of identical species in subtropical marine invertebrate faunas in widely separated regions. In order to establish correlation, we should look for equivalent stages of evolution in relation to preceding and subsequent faunas, and not expect a greater number of identical species than are found in the contemporaneous faunas of distant areas at the present day. Mr. Dall adopts the grouping of Eogene to include Eocene and Oligocene, and Neogene to include Miocene and Pliocene, and he gives detailed lists of fossils. He discusses the physical changes that have taken place, and agrees that no discontinuity of the link between N. and S. America from the Miocene to the present time is probable, and certainly none amounting to a free communication between the two oceans.

A pamphlet on "Rock Phosphates and Other Mineral Fertilisers" has been issued by Dr. Charles Chewings (C. E. Bristow, Adelaide, S. Australia). The object is to give descriptions of the deposits from which mineral fertilisers originate, with notes on the preparation of the phosphate for the market, as an aid to the prospector and to others engaged in the practical applications of the manures. Particulars are given of phosphate deposits in all parts of the world, but special reference is made to those of Clinton, on Yorke's Peninsula, in South Australia. Here a range of hills, formed mainly of Cambrian rocks, rises to an elevation of nearly 400 feet, and beneath the crest, in a N.E. and S.W. direction, the rock phosphate occurs. It extends for more than 104 chains, varies in width from 8 to 20 chains, and is covered to a considerable extent by alluvial deposits. No fossils have been found in the deposit, and the author gives reasons for believing it to have been derived from guano. Selected samples can hardly be distinguished from the phosphate rock of Christmas Island.

According to Mr. E. O. Hovey (*Science*, November 13) the ascending obelisk of Mont Pelée, of which we reproduced an illustration from a photograph taken on June 13 (NATURE, October 1), has since disappeared. Meanwhile, the dome of the cone surmounting the crater has been greatly altered, and a small spine issued from it early in September. This was pushed up 20 metres within a week, and then destroyed by an eruption. Eruptions giving rise to great dust clouds led to the expectation that further serious disturbances might take place. The latest bulletins (October 1 to 19), however, indicate only feeble activity of the volcano.

We have received the subject list of works on the mineral industries and allied sciences in the Library of the Patent Office. This is a helpful guide to the literature of various subjects, and these are arranged under headings of which assaying, clay and clay industries, coal and coal mining, geology descriptive and applied, lead, limestone, peat, uranium and zinc may be taken as examples. The list is, of course, confined to the works in the Patent Office, and it contains titles of a few books and pamphlets that are worthless from a practical point of view, such as "King Coal's Levee" (1820). Institutions should have authority to part with works of this kind, so that they might be placed in appropriate libraries. The practical utility of the list is, however, great, and the price is only 6*d*.

Some Jurassic fossils from Borneo have been described by Mr. R. Bullen Newton (*Proc.* Malacol. Soc., v., October). These include a new species of Trigonia (*T. Molengraaffi*), the genus being recorded for the first time from the rocks of Borneo. The characters of the fossils indicate that the strata belong to the Lower Oolites.

In some notes on the origin of coral reefs (*Amer. Journ. Sci.*, September) Mr. J. Stanley Gardiner remarks that while some reefs may possibly owe their existence to the subsidence of the land round which they originally formed only a fringe, yet the facts collected during recent years prove that such a method of formation was rare and exceptional. Referring to the Maldive group, he shows that a study of the reefs indicates the following stages:—(1) a basis of primitive rock cut down by the action of currents, &c., and lying at a depth of about 200 fathoms in a sea of more than 2000 fathoms; (2) upgrowth of a shoal by means of deep-sea corals assisted by other organisms; (3) outward extension of the reef by means of detritus; (4) surface reef formed by corals, &c.; (5) land, formed by piling up of sand and rubble on the reef; and (6) lagoon, formed partially by the more rapid growth of the organisms on the edge of the original bank, building up an encircling reef, and partially by the solution and erosion of the central parts.

BIOLOGICAL TREATMENT OF SEWAGE.

FOR some years a very interesting series of experiments in connection with the biological method of sewage treatment has been carried on by Dr. Dunbar, director of the Hygienisches Institut at Hamburg, and by his colleagues. Special attention has been directed to the elucidation of the sequence of changes which underlies the purification process in contact beds and percolating filters.

The most recent conclusions are given in a paper read by Dr. Dunbar at the International Congress of Hygiene and Demography at Brussels, and in several papers in the *Gesundheits-Ingenieur*, more especially in one by Messrs. Kattein and Lübbert in No. 25 of that journal. Great importance is attached by the Hamburg workers to the *rôle* played by the process of so-called "absorption" which takes place when the liquid is in contact with the purifying medium. It has been found that sterile clinkers have the power of withdrawing from solution not only colouring matters, but also the highly complex nitrogenous bodies found in sewage.

The exact meaning to be given to the term absorption is carefully discussed by Kattein and Lübbert in their paper, with copious references to the literature of the subject. It is defined as a purely surface action independent of chemical attraction, analogous, in fact, to the condensation of carbonic acid on glass threads observed by Bunsen.

The purification of the sewage by the ordinary biological methods is considered, in the first place, to be due to the "absorption" by the medium of the putrefactive matters in solution, which are afterwards oxidised through the intervention of micro-organisms. Without the activity of the organisms in presence of oxygen, absorption soon ceases.

The absorptive effect increases with the surface exposed, *i.e* with the fineness of the material. Very considerable reduction of impurities can be effected by a contact of a few minutes, and the effect practically attains its maximum in from four to six hours.

Besides the destruction of the absorbed organic matter, which is due to micro-organisms, some oxidation is effected directly by the atmospheric oxygen, which is also absorbed, and which is shown to be in a specially active condition, as it is capable of instantly oxidising hypochlorites to chlorates, and, more remarkable still, of converting dimethyl-aniline into methyl-violet. The last change can only be brought about in the ordinary way by heating with chlorate, or other powerful oxidising agent.

An interesting example of absorption is seen in the case of the percolating filter adopted by Dr. Dunbar. This filter is provided with a layer of fine material on the surface, about six inches deep. According to Dr. Dunbar, 50 per cent. of the purification, apart from nitrification, takes place in this six inches.

THE ORIENTATION OF THE ANCIENT CHURCHES OF IRELAND.[1]

PROF. J. P. O'REILLY'S paper, although mainly antiquarian, presents certain points of scientific interest worth attention for their novelty and possible application elsewhere. The two churches in question are easily accessible from Dublin, but they have not been fully and sufficiently examined. The author examines what is known of the saint to whom both the churches are said to be dedicated, giving citations from the public records relative to the saint's name and its various forms. He shows that there are at least four different saints of the name of Begga mentioned having different festival days, and points out the admitted uncertainty existing as to the dedicatory saint in question. As a solution, he takes into account the orientation of Dalkey Town Church, assuming that the church was oriented to the rising sun of the saint's festival day. The older or western part of the church is oriented E. 8° 10′ N., while the newer or eastern part or chancel has that of E. 9° 30′ N. He finds the sun to present a northing corresponding to these figures between April 11 and 15 on his passage northward, and between August 29 and *September* 2 on his passage southwards. "As regards," he says, "the festivals of saints mentioned as occurring between August 29 and September 2, the nearest in date would be that of St. Bega (September 3) (the saint venerated at Dunbar)." Hence he draws the conclusion that she was the particular St. Bega to whom the church was dedicated.

Prof. O'Reilly then considers the church on Dalkey Island, points out its remarkable position, gives the details of its structure, and argues that the belfry (so called) was most probably used as an observatory for the determination of the equinox in particular, and for the observation of the stars so as to fix the hours of service. This argument he supports by several citations and a description of the meridian line, with inscriptions, existing in St. Sulpice Church, Paris. He then compares the south-east window now existing in the Dalkey Island church with that of Dalkey Town Church, and shows their close relation in certain respects. This leads to a detailed examination of the south-east opening of Dalkey Town Church, its dimensions and probable use, for the determination of the saints' festival day by the stoppage of the sunlight rays through it at certain times of the year. He shows that this would happen for one of the compartments of the window on April 9 and *September* 4, so that here again the festival day of St. Bega of Dunbar is pointed out. As regards the orientation of Dalkey Island church, he shows that it is about E. 3° south, not due east. He explains this error from the nature of the ground as previously described, and further points out how the true east and west line is given, and was apparently fixed, by a line passing through a Greek cross carved on a rock opposite the western door, and the north-west angle of the church. Lastly, his measures having been made metrically, he finds that the unit of measurement used in the building was the Spanish "Vara" = 0·835m., and gives proofs of this. He thus raises the broad and interesting question of the unit or units of measurement having been in use in Ireland previous to the adoption of the British standard of feet and inches, and invites further investigation in this respect.

[1] "Notes on the Orientations and Certain Architectural details of the Old Churches of Dalkey Town and Dalkey Island, Dublin." By Prof. Jos. P. O'Reilly. Abstract of paper read before the Royal Irish Academy, February 23.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—Mr. W. H. Young, Peterhouse, has been approved for the degree of Doctor of Science.

A vacancy for a university lecturer in histology has been caused by the election of Dr. Langley to the chair of physiology. The appointment will be made in the Lent term, 1904.

Dr. Dickinson, Dr. Rolleston, and Dr. Kellock have been appointed additional examiners for medical degrees on account of the large number of candidates in the present term.

The Walsingham medal for biology has not been awarded this year

The Sheepshanks astronomical exhibition is awarded to Mr. P. E. Marrack, one of the senior wranglers of the year.

The observatory syndicate proposes that the office of assistant director of the observatory should be conferred on Mr. H. F. Newall, who has been observer since 1890, without stipend.

The graces for the organisation of the school of geography were opposed in the Senate on December 5, but were carried by large majorities. A board of studies, a special examination for the ordinary B.A. degree, and a diploma in geography are thereby established.

SIR WILLIAM MATHER will distribute the prizes at the Merchant Venturers' Technical College, Bristol, on Thursday, December 17.

A GIFT of 50,000*l*. has been made by an anonymous donor to University College, London, through Prof. Starling, to be used by the council of the college for the promotion of higher scientific education and research at that institution.

MR. JOHN D. ROCKEFELLER has, we learn from *Science*, offered to give Vassar College 40,000*l*., or such part of this sum as may be equalled by gifts from other sources before June, 1904. 10,000*l*. has so far been subscribed, and an appeal is made for further gifts.

THE annual meeting of the Association of Technical Institutions will be held at the Leathersellers' Hall, London, on Friday, January 29, 1904. Sir John Wolfe Barry, K.C.B., F.R.S., will occupy the chair, and an address will be given by the president-elect, the Right Hon. Sir John E. Gorst, K.C., M.P.

IT is announced from New York that the committee to control the selection for the Rhodes scholarships available for Americans has been formed. The presidents of Yale and Harvard Universities are the principal members of the committee, which also includes one representative from each State in the Union.

THE University of Ottawa was totally destroyed by fire on December 2. More than five hundred students from all parts of Canada, the United States, and Mexico were in residence. Fortunately they escaped, but several professors were injured, none, however, fatally. Everything in the building was destroyed, the total loss being estimated at 500,000 dollars.

THE first meeting of the court of the University of Liverpool was held on December 5, when Sir Edward Lawrence, Pro-Chancellor, presided. During the course of an address, proposing the adoption of the report and accounts, the chairman said the university had started its career with a property in land, buildings, and investments having a value of more than 500,000*l*. The subscriptions to the university movement in Liverpool amount to 170,000*l*.

A CONFERENCE was held on December 4 between the consultative committee of the Board of Education and representatives of various professional bodies in order to discuss the desirability and feasibility of the introduction of a system of school leaving certificates for England. Similar conferences with representatives of universities and of the teaching profession have previously been held. Lord Londonderry attended the conference for a short time in order to say a few words on behalf of the Board of Education. Sir W. Hart Dyke subsequently took the chair.

MR. R. B. HALDANE, K.C., M.P., presented the prizes and certificates at the Borough Polytechnic, Southwark, on December 4. In the course of his address, Mr. Haldane said that with regard to the movement for the creation of a great school of technology in London, there had been a certain amount of mystery as to its relation to polytechnics and its position generally. The reason that nothing had yet been disclosed was because things were moving, but with such deliberation that it was inexpedient to present pictures of the end when they had not got much beyond the beginning. They were only in the early stages at the present time. Conferences were taking place with various

experts, and it was hoped that the combined effort of the trustees of the Rosebery scheme, the Government, the great city companies, and the London University would produce a school which would be worthy of London. There would be no overlapping, but they would try to fill up the gaps, and the polytechnics would be linked to this higher school.

A School Nature-Study Union has been established to utilise and make better known facilities which already exist to encourage the study of nature by pupils in primary and secondary schools, and to supplement by work in several new directions the efforts of existing associations. The prospectus of the Union states that it is proposed to promote addresses to children by supplying lantern slides and specimens to teachers desirous of giving lessons on natural objects, and by providing qualified lecturers where desired; to assist in the organisation of school rambles and journeys, in the establishment of school museums and in the arrangement of conferences and natural history field days. The inauguration of a junior department, of reading circles, of circulating libraries for teachers, is also contemplated, as well as the publication of an official organ. Sir George Kekewich, K.C.B., is the president, and the Rev. C. Hinscliff, Bobbing, Sittingbourne, is the hon. secretary of the Union.

At the annual meeting of the governors of Yorkshire College on Monday, reference was made to the charter for the new university. Donations amounting to 36,000*l.* have been promised, provided that the sum of 100,000*l.* is raised. It is essential that their annual income should be largely increased if the new university is to take the position to which its central position among the industries of Yorkshire entitles it. Lord Allerton, who presided, remarked that they had reached the stage when they might consider the charter assured. The only point raised against the title of "The Victoria University of Yorkshire" was that it might clash with that of the Victoria University of Manchester, but Lord Allerton thought the distinction was well marked. A resolution was passed authorising the council to make any alterations in the draft charter which might appear to them desirable, and to promote a Bill for the incorporation of Yorkshire College in the university when founded, and to take such steps as would tend to secure the foundation of a university for Yorkshire.

Sir W. Anson, M.P., Parliamentary Secretary to the Board of Education, distributed the prizes to the students at the Goldsmiths' Company's Technical Institute, New Cross, S.E., on December 2, and delivered an address on education, during which he urged the claims of a wide culture and of a broad curriculum. In the course of his remarks Sir William remarked it was no disparagement to language, to history, and to literature to say that they did not explain the wonders of the world around them. It was no disparagement to science to say that it did not reveal to us the great facts and the great thoughts of the men of the past. He believed that practical business men were beginning to find that a liberal education was a good foundation for subsequent scientific and technological study when that had to be applied to business. They were beginning to discover that a man who had had what he would call a liberal education in language, history and literature had thereby laid a good foundation for scientific study or technological study, and that he was more useful for practical purposes than the man who had devoted his whole life to the limited area of one subject of scientific or technological pursuit.

A conference of Welsh county councils' representatives on the question of establishing a school of forestry for Wales and Monmouthshire was held recently at Haverfordwest. Mr. E. Robinson, of Boncath, who inaugurated the movement, explained that their object was to plant waste and at present unproductive woodlands in Wales. A school could be established with 100 to 200 acres of land to start with, and the option of acquiring a further 500 or 800 acres, and the total capital outlay ought not to exceed 5000*l.* to 8000*l.*, which could be contributed by the councils according to their rateable values. He believed the Government would contribute about half the amount required, and he assumed that an annual grant of 100*l.* from each of the councils would be sufficient to cover all out-of-pocket expenses, and give a good return on capital. There were about a million acres of waste land in the Principality which could grow timber. The planting would cost not more than 6*l.* an acre. Spread over thirty years, that would require a yearly grant of 100,000*l.* from the Government, the money to be repaid in that period by half-yearly instalments, and by the end of that time they should have plantations worth from 30,000,000*l.* to 40,000,000*l.* In the whole country there were 21 million acres of waste land and quite 8 millions suitable for planting, which in fifty years would be worth fully 650,000,000*l.* sterling. A resolution was adopted that it was desirable to establish a school of forestry for the whole of South Wales and Monmouthshire.

Mention has already been made (p. 70) of the conference of teachers to be held on January 7–9 under the auspices of the Technical Education Board of the London County Council. The meetings will be held, as in previous years, at the South-western Polytechnic, Manresa Road, Chelsea, S.W. The arrangements for the first day have been made in conjunction with the Geographical Association, and those for the second day in conjunction with the Modern Language Association. The subjects to be discussed in connection with the teaching of geography were announced in our previous note on the meetings. At the sixth meeting, on Saturday, January 9, at 2 o'clock, Prof. J. Perry, F.R.S., will take the chair. Addresses will be delivered by Mr. W. Hibbert on "New Apparatus for the Teaching of Electricity and Magnetism," and by Mr. R. W. Bayliss on "Practical Work in the Teaching of Geometry." A large exhibit of maps, globes, slides and apparatus illustrative of practical methods of teaching geography has been collected by the Geographical Association. Short explanatory lectures will be given on the collection on Tuesday afternoon, January 5, and every subsequent afternoon during the week. There will also be an important art exhibition, including an interesting loan collection of fifteenth and sixteenth century herbals and finely illustrated botanical works, together with a number of plant drawings by John Ruskin and his pupils. No charge will be made for admission to the conference or exhibitions. Application for tickets of admission should be made to Dr. Kimmins, 116 St. Martin's Lane, W.C., or Mr. C. A. Buckmaster, 16 Heathfield Road, Mill Hill Park, W.

In an address at the Municipal Technical Institute, West Ham, on Thursday last, Sir William White remarked that both elementary and higher technical education are necessary for national progress. There is the technical education which belongs to those who are trained from the first with the idea of becoming directors, managers, heads of businesses. This may be called the higher technical training for those who are intended to be captains of industry. Both kinds of training are necessary. The time has passed when the idea prevailed that technical instruction for the artisan should be limited to the workshop or the factory. Skill in handicraft and knowledge of practice and precedent no longer suffice. Every man engaged in industrial work should have the opportunity, if he so desires, of acquiring a knowledge of principles as well as of processes. For the workers themselves such knowledge is advantageous. Work done intelligently must be better done. From well-instructed workers better results are obtained than from others not so well informed. It is reasonable, also, to anticipate that from trained men should come more valuable suggestions for improvements in methods and processes that may reduce the cost of production and advance manufacture. In the stress of industrial competition, ever increasing in severity, it is absolutely necessary to the maintenance of our national position in the markets of the world that no advantage which technical training can give should be unrealised. Elementary technical instruction adapted to the working classes is by common consent a necessity of any scheme of State-aided technical instruction, and it seemed to Sir William White that to devote attention solely to higher technical instruction and to lavish our resources upon it exclusively, or even chiefly, would be a fatal mistake in the national interest. For sixty years the Admiralty has had a system of technical training for dockyard apprentices at the Royal dockyards, and there is no system of elementary technical education in existence that, in his judgment, has been so thoroughly proved. It is no exaggeration to say

that this Admiralty system of training has produced the majority of the men who are now occupying the leading positions in the shipbuilding industry of this country; that it has given to the private shipbuilders its leaders, who have risen from the working classes; and that it has produced many men holding responsible positions in other parts of the world.

SOCIETIES AND ACADEMIES.

LONDON.

Chemical Society, November 18.—Dr. W. A. Tilden, F.R.S., president, in the chair.—The union of carbon monoxide and oxygen, and the drying of gases by cooling, by Mr. A. F. **Girvan**. A series of experiments with various cooling agents was made, to determine whether aqueous vapour could be so far removed from mixtures of these two gases by cooling that they could no longer be exploded electrically. It was found that after having been cooled to a temperature of $-35°$ the mixture exploded feebly, and that if it had been cooled to below $-50°$ explosion did not occur; whence it appears that there must be at least one molecule of water in 24,000 molecules of the mixture in order that such mixtures may explode.—Simplification of Zeisel's method of methoxyl and ethoxyl determinations, by Dr. W. H. **Perkin**, sen., F.R.S. The vertical condenser and washing bulbs are dispensed with, it having been found that the hydriodic acid is completely retained by using a long-necked distilling flask with its side arm arranged to slope slightly upwards.—The rusting of iron, part ii., by Dr. G. T. **Moody**. The salts which inhibit the formation of "rust" on iron are divisible into two classes, viz. those which are strongly alkaline, and therefore absorb carbon dioxide, *e.g.* sodium phosphate and borate, and those which are decomposed by carbon dioxide, *e.g.* sodium nitrite, acetate, and formate. The author is of opinion that the non-formation of "rust" in presence of these salts is due, therefore, to their removal of carbon dioxide from the air, and not, as was suggested by Dunstan, to their property of destroying hydrogen peroxide.—Constitution of ethyl cyanoacetate. Condensation of ethyl cyanoacetate with its sodium derivative, by Messrs. F. G. P. **Remfry** and J. F. **Thorpe**.—The action of water and dilute caustic soda solutions on crystalline and amorphous arsenic, by Mr. W. T. **Cooke**. Amorphous arsenic is dissolved to a minute extent only, by prolonged ebullition of the element in water or aqueous solutions of sodium hydroxide even in presence of air. The crystalline form of the element, on the other hand, is also only slightly soluble in water and caustic soda solutions in presence of inert gases, but in presence of air the solubility is greatly increased.—Note on a double chloride of molybdenum and potassium, by Prof. G. G. **Henderson**. A description of the method of formation and of the properties of this salt, the composition of which is represented by the formula $3KCl,MoCl_3,2H_2O$, was given.—The action of benzamidine on olefinic-β-diketones, by Dr. S. **Ruhemann**.—Dissociation constants of trimethylenecarboxylic acids, by Messrs. W. A. **Bone** and C. H. G. **Sprankling**. A comparison of the values of these dissociation constants with those of the corresponding saturated open-chain acids shows that the formation of a closed ring increases the values of these constants.—The elimination of hydrogen bromide from bromo-*gem*-dimethylsuccinic acid and from bromotrimethylsuccinic anhydride, by Messrs. W. A. **Bone** and H. **Henstock**.

Mineralogical Society, November 17.—Dr. Hugo Müller, F.R.S., president, in the chair.—Mr. R. H. **Solly** gave a detailed description of various minerals from the Binnenthal, five of which had not been identified with existing species. These five minerals all contain lead, arsenic and sulphur, but sufficient material for complete analyses has not yet been obtained. Three of them are red transparent minerals having each one perfect cleavage and a similar vermilion streak, but differing crystallographically: one is apparently orthorhombic with (100), (110) = 39° 16′, (010), (011) = 52° 57′ and (001), (101) = 42° 43′; another is oblique with $\beta = 78° 46'$, (100), (101) = 42° 22′ and (010), (111) = 37° 3′; while the third has a zone at right angles to the perfect cleavage with angles of approximately 30° and 60°. The other two minerals, which could not be identified with any of the other sulpharsenites of lead previously described by the author, are black with metallic lustre. One of these is oblique with $\beta = 81° 11'$, (100), (101) = 40° 7′, (010), (111) = 55° 26′; it has a perfect cleavage (100), and, like liveingite, exhibits no oblique striations on the planes in the zone [100, 001]. The other mineral is also oblique with $\beta = 89° 40'$, (100), (101) = 46° 18′, and (010), (111) = 59° 56′; it has a perfect cleavage (100), and, like rathite, exhibits numerous oblique striations on the planes in the zone [100, 001]. On fine brilliant crystals of sartorite recently obtained by the author he has been able to confirm the oblique symmetry which he had previously announced, and to determine accurately the elements, $\beta = 88° 31'$, (100) (101) = 54° 45′, (010) (111) = 69° 52½′. Amongst other specimens from the dolomite of the Lengenbach in the Binnenthal, the author exhibited and described peculiar rounded crystals of galena resembling seligmannite, hyalophane crystals twinned according to the Carlsbad law and showing three new forms, a green mica which was determined to be anorthic, albite and biotite, minerals which have not yet been hitherto recorded from the locality, and barytes in green crystals. Of specimens from the Ofenhorn, the author exhibited some remarkably fine crystals of anatase, and crystals of laumontite, a mineral new to the locality.—Mr. L. J. **Spencer** described crystals of adamite from Chili which were remarkable for their strong pleochroism.—Mr. G. F. Herbert **Smith** discussed the prismatic method of determining indices of refraction. From observations of the angles of incidence and deviation the refractive index and direction of the wave-front in the crystalline medium could be found. By using pairs of faces in the same zone and different angles of incidence a series of refractive indices is obtained which, when plotted with the direction angle as ordinate, gives in general a double curve. Three of the critical values are the principal indices, the fourth corresponding to the direction parallel to the zone-axis. The angles of polarisation with respect to the zone-axis provide a means of discriminating between the doubtful values. A description was given of an inverted goniometer whereby observations could be made in media other than air.

Linnean Society, November 19.—Prof. S. H. Vines, F.R.S., president, in the chair.—The Rev. John **Gerard**, S.J., exhibited a fasciated rose sent by the Rev. J. Dobson, of St. Ignatius's College, St. Julian, Malta, with this note:—"A freak of a white climbing rose, in which eight or nine blossoms with their stalks have grown together."—The Rev. R. Ashington **Bullen** brought for exhibition an albino mole, from a farm near Bagshot; it was wholly of a light fawn colour, and no similar specimen had been seen for at least twenty years, though many moles had been trapped on the same farm.—Dr. M. T. **Masters**, F.R.S., gave an abstract of his paper, a general view of the genus Pinus. The author stated that the object of the paper was to discuss the nature and value of the characters made use of in discriminating the various species of Pinus, and to supply additional points of distinction derived from the anatomical structure of the leaf and other sources. The author has framed an analytical table of the species, which, although mainly artificial, may be of assistance hereafter in facilitating the determination of the species, and in arranging them in more natural groups. The two main divisions adopted are the thin-scaled pines or Tenuisquamæ, and the thick-scaled pines or Crassisquamæ, according to the relative thickness of the cone-scales. Further subdivisions are founded on various points of distinction.—Contributions to the embryology of the Amentiferæ, part ii., *Carpinus Betulus*, by Dr. Margaret **Benson** and Miss Elizabeth **Sanday**. More than 500 accurately orientated, stained and mounted series of sections were obtained through ovules containing the earlier stages in the development of the numerous embryo-sacs, until the segmentation of the definitive nucleus and of the egg occurred. Former observations (see part i. in *Trans.* Linn. Soc., ser. 2, bot. iii. (1894), pp. 409–424) were confirmed and the following new facts obtained. The polar nuclei meet at the neck of the cæcum, descend together and ultimately fuse near its base. The pollen-tube enters the sac in their vicinity, and provides some means of exit for one male gamete, which seems to be emitted into the cæcum

and makes its way to the definitive nucleus. Meanwhile the other male gamete is carried up by the tube and emitted into the substance of the egg, with which it fuses after a short delay. A wall is now formed round the egg, and when a considerable amount of endosperm is present, segmentation of the egg commences.

Royal Microscopical Society, November 18.—Dr. Hy. Woodward, F.R.S., president, in the chair.—Dr. Ed. **Horder** exhibited and described a metal clinical case for blood film work, &c.—Mr. **Taverner** exhibited on the screen two photographs of the leg of a water-mite which he had taken through the separate tubes of a binocular microscope to demonstrate that the images were dissimilar and capable of producing a true stereoscopic effect; if they were alike, the apparent solidity of the object as seen through the binocular microscope would be only a mental effect. He also exhibited in a stereoscope enlarged prints of the pair of photographs, which clearly showed that a true stereoscopic effect was produced.—Prof. J. D. **Everett**, F.R.S., read a note on Lord Rayleigh's paper of 1896, one part of which he had found specially difficult, namely, that in which the transition is made from direct to oblique illumination of a grating under the microscope. He had recently found a more direct mode of deducing the results there established, and that was set forth in the present communication. Lord Rayleigh, to whom he had submitted the note, said that on a cursory examination the new method of deduction seemed to be correct. Prof. Everett then proceeded to explain his proof by diagrams and formulæ on the blackboard.—Mr. W. **Wesché** gave a *résumé* of his paper on the mouth parts of the Nemocera and their relation to the families in Diptera, illustrated by a number of drawings shown on the screen by the epidiascope, and mounted specimens exhibited under microscopes.

Cambridge.

Philosophical Society, November 23.—Dr. Hobson, vice-president, in the chair.—The horse in Iceland and the Færöes, by Mr. F. H. A. **Marshall** and Mr. Nelson **Annandale.**—Note on the proportion of the sexes in *Carcinus maenas*, by Mr. R. C. **Punnett.**—On the transmission of earthquake waves through the earth, by the Rev. O. **Fisher.**—The action of ultra-violet light on moist air, by Mr. J. H. **Vincent.**—Experiment to show that negative electricity is given off by a metal exposed to Röntgen rays, by Prof. **Thomson,** F.R.S. Dorn, as well as Curie and Sagnac, have in different ways shown that a metal exposed to Röntgen rays gives out kathode rays; this can be shown very simply by mounting a small gold-leaf electroscope on a quartz support in a vessel in which a very good vacuum can be produced; when the vessel is exhausted and the gold leaves exposed to Röntgen rays they diverge, and on testing they are found to have a charge of positive electricity. If before exposure to the rays the leaves are charged negatively, then when the rays are applied the leaves at first collapse and then diverge, while if the initial charge is positive the divergence of the leaves increases from the time of putting on the rays. In this way is obtained a very direct proof that the gold leaves when exposed to the rays acquire positive and lose negative electricity.

Manchester.

Literary and Philosophical Society, November 3.—Prof. W. Boyd Dawkins, president, in the chair.—A collection of wind-worn pebbles of quartz and quartzite from an old raised beach near Waverley, North Island, New Zealand, together with photographs, was exhibited by the president. They have been cut by the sand driven by the wind into the characteristic *Dreikanter*, and might easily be mistaken for the work of the hand of man. The direction of the prevalent winds is shown by the amount of work done on each side or facet, the texture of the wind-worn being quite different from that of the wave-worn surfaces. The collection and photographs were made by Lady Constance **Knox** in 1900, and they will be given to the Manchester Museum, Owens College.—Mr. H. E. **Schmitz** gave an account of his experiments on the specific heats of metals at low temperatures. The author gave a summary of his determinations of the specific heats of various metals:—(1) between the temperature of liquid air and the ordinary temperature; (2) between the ordinary temperature and the temperature of steam. For the former temperature range two methods were used. Of these the first was the method of mixtures. The second method is similar in principle to Joly's well-known method of steam condensation, but here the weight determined is that of a deposit of ice. The final results show a variation of specific heat considerable in all cases, but more marked for metals of low than for metals of high atomic weight. This is shown by the following ratios of specific heat for lower range to specific heat for higher range for various metals:—aluminium 0·79, nickel 0·77, cobalt 0·78, copper 0·85, zinc 0·90, silver 0·92, tin 0·90, thallium 0·92, lead 0·96.

Paris.

Academy of Sciences, November 30.—M. Albert Gaudry in the chair.—On the scapular and pelvic fins of fishes, by M. Armand **Sabatier.**—Observations made at the island of Réunion on the eclipse of the moon of October 6, by MM. Edmond **Bordage** and A. **Garsault**. The observations were much hindered by clouds, only two good photographs being obtained, one being at the moment of greatest shadow.—The last sun-spot minimum, and remarks on the subject of the law of zones, by M. J. **Guillaume.** It is suggested that the distribution of sun-spots in latitude has not followed the law of zones, due to Spörer.—The problem of Cauchy relating to a particular class of surfaces, by M. W. **de Tannenberg.**—On the effective representation of certain discontinuous functions, as limits of continuous functions, by M. Émile **Borel.**—On a class of functional equations, by M. S. **Lattès.**—Articulations with a flexible plate, by M. A. **Mesnager.**—On the temperature of flame, by M. Ch. **Féry.** After a critical examination of the errors involved in the use of thermocouples, an alternative method is proposed in which no solid body is introduced into the flame. The measurement is made by the production of the reversal of a metallic line, by means of rays emitted by a solid body carried to any convenient temperature. The method is accurate to about 10° C., and has been applied to the determination of the temperatures of a Bunsen flame, an acetylene flame, alcohol, hydrogen, and oxyhydrogen blowpipe flames.—On some phenomena presented by mercury arcs, by M. **de Valbreuze.** Some of the peculiarities observed in starting the arc appear to indicate the existence of a superficial membrane on the mercury which opposes the passage of the current, especially in the cold.—On the suppression of magnetic hysteresis by the action of an oscillating magnetic field, by M. Ch. **Maurain.** Some recent experiments by M. Marconi and M. Tissot on a new receiver for wireless telegraphy have directed attention to the action of a rapidly varying magnetic field upon magnetisation produced under ordinary conditions. This action is attributed by M. Marconi to the suppression of the time lag, by M. Tissot to a modification of ordinary hysteresis with respect to the field. The quantitative experiments of the author agree with the latter of these hypotheses.—On the law of regular distribution of total magnetic force of the earth in France on January 1, 1896, by M. E. **Mathias.**—The magnetic anomaly of the Paris basin, by M. Th. **Moureaux.**—On the fusibility of mixtures of the sulphides of bismuth and silver, and of the sulphides of bismuth and antimony, by M. H. **Pélabon.** The fusibility curve of mixtures of bismuth and silver sulphides is a polygonal line presenting two minima and a maximum, the latter corresponding to a definite compound of the formula $Ag_2S.4BiS$.—Stimulating or paralysing influences acting upon manganese considered as a ferment, by M. A. **Trillat.** A study of the precise conditions under which the maximum oxidising effect is obtained from small quantities of manganese salts, acting as metallic ferments.—The systematic alkylation of arsenic, by M. V. **Auger.** An extension of Meyer's reaction; sodium methylarsenate is reduced by sulphurous acid to methylarsine oxide, and this is treated with methyl alcohol, soda, and the alkyl iodide.—The separation of iodine in the state of alkaline salt from bromides and chlorides by its transformation into iodic acid, and on the preparation of pure iodine, by MM. H. **Baubigny** and P. **Rivals.** The solution is oxidised in alkaline solution with potassium permanganate, the iodine

being thus converted into iodate, and after the addition of copper sulphate the bromine is distilled off in a current of air. On acidifying with sulphuric acid the chlorine can then be distilled off. Test analyses are given.—The microscopic study of the prehistoric bronzes of the Charente, by M. G. **Chesneau.**—On the eggs of *Bombyx Mori*, by M. Jules **Gal.**—On the egg production, fecundity, and sexuality in carnivorous fowls, by M. Frédéric **Houssay.** On the infectious exophthalmia of certain fresh-water fishes, by M. J. **Audigé.**—Contribution to the cytological study of the Ascomycetes, by M. **Guilliermond.**—On the geological synthesis of the eastern Alps, by M. Pierre **Termier.**—On a remarkable case of spontaneous crystallisation of gypsum, by M. Stanislas **Meunier.**—Luminous sensation as a function of the time for coloured light: technique and results, by MM. André **Broca** and D. **Sulzer.**—On the prediction of the yield of the sources of the Vanne, by M. Edmond **Maillet.**

DIARY OF SOCIETIES.

THURSDAY, DECEMBER 10.

ROYAL SOCIETY, at 4.30.—On the Integrals of the Squares of Ellipsoidal Surface Harmonic Functions: Prof. G. H. Darwin, F.R.S.—Preliminary Note on the Resistance to Heat of *B. Anthracis*: A. Mallock, F.R.S., and Lieut.-Col. A. M. Davis.

MATHEMATICAL SOCIETY, at 5.30.—Proof of a Formula in Elliptic Functions: Mr. R. J. Dallas.—On Many-valued Newtonian Potentials: Prof. A. C. Dixon.—A Generalisation of Neumann's Expansion of an Arbitrary Function in a Series of Bessel's Functions. Rev. F. H. Jackson.—Modes of Convergence of Infinite Series of Functions of a Real Variable: Dr. E. W. Hobson.—On Normal and Antinormal Piling: Prof. J. D. Everett.—On the Distribution of the Points of Uniform Convergence of a Series of Functions: Mr. W. H. Young.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Presentation to representatives of the Borough of Colchester of a historical picture representing Dr. Gilbert in the act of showing his electrical experiments to Queen Elizabeth and her Court.—The Slow Registration of Rapid Phenomena by Strobographic Methods: the "Ondographe" and "Puissancegraphe" (Wave Recorder and Power Recorder): M. E. Hospitalier.—The Magnetic Dispersion in Induction Motors, and its Influence on the Design of these Machines: Dr. Hans Behn-Eschenburg.

SOCIETY OF ARTS, at 4.30.—India's Place in an Imperial Federation: J. M. Maclean.

FRIDAY, DECEMBER 11.

PHYSICAL SOCIETY, at 8.—A Method of Mechanically Reinforcing Sounds: Rev. T. C. Porter. The Simmance-Abady "Flicker" Photometer: Messrs. Simmance and Abady.—Exhibition of a Conductometer: R. Appleyard. A Model to illustrate various Properties of Wave-motion: Prof. L. R. Wilberforce.

ROYAL ASTRONOMICAL SOCIETY, at 5.—The Rotation Period of the Planet Saturn: W. F. Denning.—The Shower of Leonids in 1903: G. W. Hough.—*Probable Papers*:—Two Drawings of the Mare Serenitatis by John Russell, R.A., affording some hitherto Unpublished Evidence as to the appearance of Linné in the Year 1788: A. A. Rambaut.—On Graphical Methods of finding the Time of Sunset at any Place: H. H. Turner.—On Oscillating Satellites; Second Paper: H. C. Plummer.—An Examination of the Relative Star Density in different Parts of the Plates forming the Harvard Photographic Star Map: J. C. W. Herschel.

MALACOLOGICAL SOCIETY, at 8.—On *Pleuronautilus pulcher*, sp. nov.: G. C. Crick.—Description of a New Species of Cassis: E. A. Smith.—On the Mollusca procured during the *Porcupine* Expedition 1869–1870, Supplemental Notes, Part I.: E. R. Sykes.—Notes on the Nervous System of Pelecypoda: R. H. Burne.

MONDAY, DECEMBER 14.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—The Patagonian Andes: Col. Sir T. H. Holdich, K.C.M.G., K.C.I.E.

VICTORIA INSTITUTE, at 4.30.—The Genesis of Nature: Rev G. F. Whidborne.

SOCIETY OF ARTS, at 8.—The Mining of Non-Metallic Elements: Bennett H. Brough. (Cantor Lectures. IV.)

TUESDAY, DECEMBER 15.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Deposits in Pipes and other Channels conveying Potable Water: Prof. J. Campbell Brown.—The Purification of Water Highly Charged with Vegetable Matter; with Special Reference to the Effect of Aëration: Osbert Chadwick, C.M.G., and Bertram Blount.

SOCIETY OF ARTS, at 8.—The British Silk Industry: Frank Warner.

ROYAL STATISTICAL SOCIETY, at 5.—The Metrical System of Weights and Measures: Alex. Siemens.

WEDNESDAY, DECEMBER 16.

CHEMICAL SOCIETY, at 5.30.—On the Relative Strengths of the Fixed Bases and of Ammonia as Measured by their Action on Cotarnine: J. J. Dobbie, A. Lauder and C. K. Tinkler.—New Halogen Derivatives of Diphenyl and Dihydroxy-diphenyl: J. C. Cain.—(1) Constitution of Nitric Peroxide; (2) Sabatier's Nitroso-disulphonic Acid: E. Divers.—Notes on some Natural Colouring Matters: A. G. Perkin and E. Phipps.—The Estimation of Methyl Alcohol in Presence of Ethyl Alcohol: T. E. Thorpe and J. Holmes.

ROYAL METEOROLOGICAL SOCIETY, at 7.30.—Some Account of the Meteorological Work of the late James Glaisher, F.R.S.: William Marriott.—On certain Relationships between the Diurnal Curves of Barometric Pressure and Vapour Tension at Kimberley, South Africa: J. R. Sutton.

ROYAL MICROSCOSICAL SOCIETY, at 8.—On the Structure and Affinities of the Genus Porosphæra: Dr. George J. Hinde, F.R.S.—Exhibition Slides illustrating the Development of an Ascidian: F. W. Watson Baker.

GEOLOGICAL SOCIETY, at 8.—The Igneous Rocks Associated with the Carboniferous Limestone of the Bristol District: Prof. C. Lloyd Morgan, F.R.S., and Prof. S. H. Reynolds.—The Rhætic Beds of England: A. Rendle Short.

SOCIETY OF ARTS, at 8.—The Science of Taxation and Business: Sir William H. Preece, K.C.B., F.R.S.

THURSDAY, DECEMBER 17.

LINNEAN SOCIETY, at 8.—On the Dacoglossa; a Study in Evolution H. J. Fleure.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.

FRIDAY, DECEMBER 18.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—An Inquiry into the Working of various Water-Softeners: C. E. Stromeyer and W. B. Baron.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Action of the Sea upon the Foreshore: C. B. Case.—The Causes of the Loss of Beaches: F. W Cable.

CONTENTS.

THURSDAY, DECEMBER 17, 1903.

GEIKIE'S GEOLOGY.

Text-book of Geology. By Sir Archibald Geikie, F.R.S. 4th Edition, revised and enlarged, 2 vols. Pp. xxi + 702; ix + 705 to 1472. (London: Macmillan and Co., Ltd., 1903.) Price 30*s*. net.

WHEN Sir Charles Lyell found that, owing to the rapid progress of geology, his early treatise must be extended beyond the limits of one handbook, he divided his subject into two parts. In the "Elements" he described the ancient changes of the earth and its inhabitants, as illustrated by geological monuments, and in the "Principles" he treated of the modern changes of the earth and its inhabitants considered as illustrative of geology. In the Elements we have a selection of facts upon which geologic history is founded; in the Principles we have a statement of the laws which have governed those changes based not only on the records of the past, but also and chiefly upon the observation of what is now going on in the present. Thus the Principles, which include that which we arrive at last, is, as its name implies, that which from an educational point of view we take first.

Sir Archibald Geikie has found that, in keeping his admirable text-book up to date, he has accumulated more material than could be conveniently contained in one volume, and has therefore issued it in two; but these are two volumes of one work, in fact the break takes place in the middle of one of his subdivisions of the subject—not inconveniently, however, as the first volume ends with the description of the aqueous deposits, and the second begins with the igneous rocks, both of which are included under structural geology. When, however, we look into the work, we see that its future is suggested not by its separation into two volumes, but by its subdivision into seven books.

The subject of the first book is the earth's place in the solar system, and the effect of the various cosmical forces acting upon it, in producing or modifying the geological condition of its crust. These have to be taken account of in discussing almost any geological question, whether glacial or volcanic phenomena, climatal conditions, the distribution of life, the age of the earth, or even such a question as the lateral erosion of river valleys, which, as some hold, depends largely upon the same influences as those which control the direction of the trade winds and ocean currents. The Garonne and the Volga, for instance, the one running north, the other running south, cling to their right bank, owing, it is suggested, to the rotation of the earth as they run at an ever increasing or decreasing distance from the axis of rotation. Although we must allow that this influence is a *vera causa*, always acting, and tending to deflect such running waters east or west, still, one cannot but feel that the variations in the level of the river beds, the winding of their courses, and the earth movements, which are known to have taken place in recent times over the areas in question, must have been far more important factors in regulating the course of the streams.

In the Second Book we learn about the materials of which the earth is composed, the chemical constituents of the crust, their mode of aggregation into what are known as minerals, and the methods of discrimination and classification of the sedimentary and igneous rocks; of rocks in the building up of which living organisms have played a part, and of rocks which have been altered by mechanical, chemical, or thermal agents so much that it is often difficult to recognise what their original character was. In this book we have glossaries of rock-forming minerals, of rocks of different composition and origin, and of various accessory substances, many of which are of economic value.

The author does not propose to treat specially of economic questions, but no one can understand the distribution and methods of obtaining coal, oil, metals, underground waters, and other products of the earth, without such a knowledge of their origin and mode of occurrence as may be gained from this work.

The Third Book deals with earthquakes and volcanoes, and has to do with the causes of upheaval and subsidence, the effects produced by internal heat, hydrothermal action, pressure and the accompanying chemical and mineralogical changes. These are subjects to which our author has paid special attention—"quorum pars magna fui," he might justly say of them—and for this reason as well as from their own intrinsic importance, we welcome his fuller treatment of them. In the second part of the same book he discusses denudation and its correlative deposition, and all the various forces of air, water, and ice, and of living things, by which they were brought about.

The changes which have taken place in the interior of the earth we should, at first sight, have thought to be one of the last subjects to which experimental research could have been applied; yet we learn that towards the end of the eighteenth century De Saussure set himself to study the possible derivation of rocks, by fusing samples of them, and judging whether, as had been alleged, some had arisen from the melting of others; but Sir James Hall more fully realised how far the processes of nature might be imitated by man, and about a hundred years ago described a series of ingenious experiments, by which he demonstrated the possibility of producing either a vitreous or a stony condition in fused rocks, according to the rate at which they are allowed to cool. Daubrée followed up this kind of experimental geology, and showed not only that various minerals usually found associated with volcanic and metamorphic rocks could be developed in the laboratory in their proper crystalline form, but also that enclosures and structures, analogous to those found in ancient schistose, and altered rocks could be artificially produced.

In Book IV. our author follows up his explanations of the *modus operandi* with an account of the results produced. He now describes the arrangement of the materials of the earth's crust, first of all considering the sedimentary rocks, their bedding and joints, their dip and strike, their cleavage and faults; also the pro-

trusion of solid masses and other phenomena connected with stratigraphical structure.

Here we have only just arrived at the end of the first volume of the present issue. The second volume begins in the middle of Book IV., with a continuation of the description of the manner in which the earth's crust has been built up and modified. This second part, however, refers to the action of internal heat and pressure, that is to say, it deals with rocks of igneous origin, whether superficial or deep-seated, and this leads to the consideration of earth movements, without which we should be unable to examine such rocks at all. Incidentally he here describes the mode of formation of veins and lodes.

Book V. gives a series of very much condensed, but still very useful notes on fossils and their place and use in geological investigations. This might be greatly extended.

Then follows in Book vi. the whole of systematic stratigraphy.

Our author arranges the stratified rocks under fifteen heads, and treats of their general characters, their flora and fauna, and their local development at home and abroad; but this, again, our author could easily develop into at least five volumes, representing the five groups under which the whole of historical geology could be very conveniently arranged.

In the seventh and last book he deals with the geographical features of the earth's surface, as affected by its geological character, and the arrangement of the materials of which it is composed.

There are buried in this text-book an immense number of facts vastly interesting to the general reader, and especially to the traveller who goes about with his eyes open, but without knowledge to follow the processes by which nature brings about the wonderful results observed. For instance, how seldom he realises when he sees the great blocks of travertine, so commonly used for building in Rome, that this *lapis Tiburtinus,* modified by Italian lips into travertino, is not a rock built up by the same kind of sediment as that of which most of the building stones he has seen elsewhere are composed, but that it is carbonate of lime which has been thrown down from chemical solution, and that plants have helped to collect it, while another similar rock, as commonly used elsewhere, has been collected by small animals, particle by particle, out of the sea water in which it was dissolved. Or if he is looking at those marvellous relics of volcanic activity, the geysers, which heap up silica instead of carbonate of lime, he will find that there also a small confervoid alga helps to collect the pasty material which afterwards hardens into flint. These are examples of scientific facts which would not force themselves upon the observation of the ordinary tourist, but which it would greatly add to his enjoyment of travel to know. Or, to take another more abstruse example, the study of the earth's satellite has suggested that the scars and pits upon it are due to the impact of aggregations of matter, and a similar bold hypothesis has been offered in explanation of certain depressions upon the earth. A basin-like hollow among the sandy mounds of Arizona was caused, it was suggested, by the impact of a meteoric body now possibly buried out of sight below, while the basin of the Atlantic, according to others, marks the area from which the material of the moon broke away from its moorings and commenced its long spiral spin round the earth. Such flights of imagination have often given us working hypotheses, which after pruning and shaping have found a place among the explanations of the order of the world. While we welcome all such tentative interpretations of phenomena, we must carefully weigh the evidence adduced, and not too hastily say proven or not proven.

The work is encyclopædic in character and arrangement, and, but that, alas! the question of cost has to be taken into consideration, we should gladly welcome its appearance in a dozen or more goodly volumes, the contents of which would be suggested by its present division into Books, some of which, as we have suggested, might be expanded into more than one volume. Then we might ask for larger type, instead of as now, 800 words to a page, and also for many more of the author's own clever sketches, and more illustrations such as those he has so judiciously selected from other sources.

NEW TEXT-BOOKS OF GEOMETRY.

Practical Plane and Solid Geometry. By I. H. Morris and J. Husband. Pp. viii+254. (London: Longmans, Green and Co., 1903.)

First Stage Practical Plane and Solid Geometry. By G. F. Burn. Pp. viii + 240. (London: W. B. Clive, University Tutorial Press, Ltd., 1903.) Price 2s.

Examples in Practical Geometry and Mensuration. By J. W. Marshall, M.A., and C. O. Tuckey, M.A. Pp. xii + 70. (London: George Bell and Sons, 1903.)

Elementary Geometry. Section ii. By Frank R. Barrell, M.A., B.Sc. Pp. viii+169 to 284. (London: Longmans, Green and Co., 1903.) Price 1s. 6*d*.

Theoretical Geometry for Beginners. Part ii. By C. H. Allcock. Pp. viii + 123. (London: Macmillan and Co., Ltd., 1903.) Price 1s. 6*d*.

Notes on Analytical Geometry. By A. Clement Jones. Pp. iv+172. (Oxford: Clarendon Press, 1903.) Price 6*s*. net.

Elementary Graphs. By W. M. Baker, M.A., and A. A. Bourne, M.A. Pp. iv+34. (London: George Bell and Sons, 1903.) Price 6*d*. net.

TEXT-BOOKS in this country which deal with the practical applications of geometry naturally follow the South Kensington division of the Board of Education, a department of the public service which has always taken a leading part in the spread of this branch of knowledge. The department has two distinct syllabuses, one for the guidance of art classes, the other for science. Both syllabuses have quite recently been revised and considerably extended, and are well abreast of the times. Although the two schemes have parts in common, there is an increasing tendency for them

to develop along divergent lines. Thus for art students one section of geometry to which great attention is paid is that relating to decorative geometrical designs, the study of which requires the drawing of many inscribed and circumscribed figures, patterns, &c. For science students this branch is of comparatively little interest. On the other hand, the geometry of vectors, a subject of first importance in science, has little attraction for the artist. Again, a student of science finds great use for his graphical constructions in the making of numerical computations, and the subject for him is becoming more quantitative in character. It is thus inadvisable to compile a text-book which shall endeavour to meet the wants of both classes of students; the first two books under review are written for science classes, and are adapted to the first stage of the revised South Kensington syllabus in Science Subject I.

The text-book by Messrs. Morris and Husband contains a large number of problems (more than 300) in plane and solid geometry, the solution of each being described in detail. The diagrams are clear and well printed, and are conveniently arranged to face the text. Each chapter closes with a useful collection of exercises. The syllabus is very completely covered as regards the matter, but the method of treatment cannot be said to correspond with its spirit. The student is told everything in minute detail. He is not sufficiently encouraged to think and invent for himself, and it is difficult to see how his interest can be maintained and his mental faculties properly developed. The method employed in problem 123 is obviously incorrect, and will no doubt be altered at the first opportunity.

In the volume by Mr. Burn, it is evident that the author's main interest centres in solid geometry, and he teaches this branch of the subject well, the student being instructed how to make simple models for himself, these being effectively used along with drawing in order to obtain a good grasp of this somewhat difficult subject. Too little attention seems to be given to plane geometry, and the student is not well grounded therein. The treatment of vectors is also meagre, and displays an inadequate conception of the scope and importance of this portion of the subject. Unfortunately some of the diagrams are needlessly small, and are trying to the eyesight.

The remaining five volumes are concerned principally with theoretical geometry. The book by Messrs. Marshall and Tuckey is a collection of nearly 550 examples arranged in groups. "The examples on practical geometry are intended primarily to lead up to geometrical reasoning, and only secondarily to give manual dexterity." Many of the examples are associated with a rider (distinguished by italic type), the truth of which will become evident as the figure is drawn, and which the reader is asked to establish by deductive reasoning. We notice with satisfaction that Euclid's method for the common tangents to two circles is discarded as unpractical. The examples in mensuration might with advantage have been a little more experimental. For instance, it would have been a satisfaction to a student to verify the numerical value of π; and an example might have been inserted asking for the area of a circle, to be obtained by the method of counting squares. The table of four figure logarithms which the authors give will prove very useful. We think that a simple table of functions of angles should also have been inserted and made use of in connection with some of the examples, especially those in mensuration. Teachers will find this large collection of examples very convenient, but its value would be enhanced by a further development on modern lines.

The second instalment of Mr. Barrell's "Elementary Geometry" comprises portions of Euclid ii., iii., iv. and vi., with some additional matter. In few of the recent text-books on the subject are the advantages of the reform in geometrical teaching more conspicuous than in this volume. While adhering to a strictly logical sequence, the author uses his new freedom to very good purpose, illustrating the propositions by experimental work, by well selected concrete examples, and by the employment of arithmetic, algebra and trigonometry. The introduction of the sine, cosine and tangent in the admirable chapter on ratio and proportion, and the subsequent judicious use of these functions, is a very good feature. The book deserves to be extensively used, and the appearance of section iii. of the work, which is in preparation, will be awaited with interest.

The first part of Mr. Allcock's geometry (corresponding with Euclid i.) was published in the early part of the year. The work is now continued, and the present part contains the equivalent of Euclid iii., 1–34, and iv., 1–9, with some additional propositions, such as the properties of the nine-point circle, and some practical applications and exercises. The title of the book correctly describes its contents and scope, comparatively little attention being given to quantitative and experimental graphical work. For those who do not wish to be tied to Euclid's sequence, and yet who desire to retain a strictly deductive system, the book will be found eminently suited. It is well written and beautifully printed; it contains a large number of easy deductive exercises distributed throughout its pages; and at the end of the volume there is a collection of practical exercises requiring numerical answers, which are given.

Mr. Clement Jones's text-book is intended for students who, having already taken an ordinary course in elementary analytical conics, wish to continue their studies and to obtain a good working knowledge of the methods of analytic research. In establishing the numerous properties of conics, the elementary theory of equations is applied in a systematic and thorough manner, in connection with which extended use is made of the single variable in the equations to the lines and curves. In a final chapter an account is given of cubic curves, the same powerful and illuminating method being employed. At the end of the volume the student will find a very useful collection of more than 200 examples, mostly taken from university examination papers, and the answers to these, with hints for solution, are appended.

The use of squared paper by schoolboys is becoming universal, and Messrs. Baker and Bourne have done

well to issue separately the chapter on graphs from their recent text-book of elementary geometry. The subject is well introduced, and the young readers are led on by easy stages and well selected examples. In connection with the plotting of sines, cosines and tangents, a short table of these functions, from which the pupils could take out their own values, would have been very instructive if it could have been provided. It seems a pity that no mention is anywhere made of the slope of a curve; comparatively few persons have yet recognised that the practice of graphing affords a valuable opportunity of helping to put into more tangible shape the idea of a *rate* which is certainly possessed in a greater or less degree even by the very young.

A CAMBRIDGE TEXT-BOOK OF PHYSICS.

Electricity and Magnetism. By R. T. Glazebrook, M.A., F.R.S. Pp. viii+440; diagrams. (Cambridge: University Press, 1903.) Price 7s. 6d.

THE present work represents a first-year course of Dr. Glazebrook's lectures in electricity and magnetism when at Cambridge. It forms one member of a series of which "Mechanics," "Heat," and "Light" have already appeared. The issue of these manuals was undertaken in response to a request that his lectures might be printed for the use, primarily, of the students attending the practical classes at Cambridge. Thus Dr. Glazebrook rather apologetically explains the publication of another book dealing with elementary electricity.

It is true that the number of elementary text-books is legion, and a man may well hesitate before adding to their number. Yet we think that there is still room, and that if a book of superlative value appears it will not fail to find a welcome.

In attempting to estimate whether the present volume is a noteworthy addition to elementary literature, let us in the first place say that it has undoubtedly many excellences. The method followed throughout is that with which we are already familiar in the other members of the series.

This method consists in mingling the theoretic and experimental sides of the subject, so that in no place is a student very far from the experimental point of view. Many of the experiments are intended apparently to be done only by the lecturer, but fifty-seven are specially described as instructions to a student. This double method involves considerable repetition, as the same statement which is made in the general text often appears again in the description of the experiment. No doubt, however, Dr. Glazebrook has found by experience that a junior student can hardly be told a thing too often, and repetition certainly does not err on the side of indefiniteness. Again, there is a considerable amount of repetition in the text itself. A general induction is made from some experiment, and this leads to a definition. The definition in many cases consists only of a repetition of the previous statements in a rather more formal shape. This, again, may be an advantage from the student's point of view, but it must be admitted that it tends to make the book rather slow. We cannot imagine anyone (except a reviewer) taking it up and reading until the small hours before putting it down. However, it is essentially a class book, and the student may acquire an enthusiasm for science from his teacher, who will amplify the somewhat categorically imparted information, hence the lack of more life is not so important.

The statements made are usually clear and logical. In some cases we are not sure of the logic. Thus, take the following sentence:—

"We have already seen that the electrification of a conductor may be the manner in which we recognise a state of stress set up in the dielectric round the conductor" (p. 40).

Should not the logic of this sentence be inverted? Is it not the stress in the medium which is directly investigated, and from which the state of electrification is inferred?

Again, in stating the law of electric force, it is asserted to follow

"as a result of the experiments, that when two similarly charged bodies are at a distance apart which is great compared with their dimensions, there is a repulsion between them which is proportional to the product of their charges," &c. (p. 44).

Is it not more logical to say that we measure the electric charges of bodies as being proportional to the mechanical forces which arise in consequence of them?

Again, the "joule" is *defined* in terms of electrical quantities. This reversal of the true logical order will mislead the student, who will fail to see that it is a purely mechanical quantity.

These may seem merely finicking criticisms, but those of us who come largely into contact with students know how difficult it is to eradicate illogical notions acquired during their early training.

In some cases the information given is not sufficient. Thus, while considerable use is made of lines of force, we are not told how they are drawn so as to represent the *intensity* of the field.

Again, the lines in the diagrams on pp. 36, 37, are drawn on a completely different system from those on pp 38, 39, and there is no hint given of this. Of course, to the ordinary student this does not matter—he is accustomed to consider physics an esoteric science; but how confusing to the real student who tries to make out what the diagrams mean.

Again, *tubes* of force suddenly appear (without introduction) on p. 186 instead of lines.

On p. 377 it is stated that

"the total E.M.F. round the secondary is proportional to the total change in the number of lines of induction linked with it."

The whole chapter on electromagnetic induction, indeed, deals only with the total E.M.F. It is nowhere defined—the student will think it identical with electromotive force.

The figures are very good and instructive. Fig. 77, which shows the screening action of an iron ring, would be improved if the *refraction* of the lines at the surface of the iron were correctly represented. Again, the lines do not crowd between the cake and cover

of an electrophorus (Fig. 39) until the cover has been earthed.

In the further editions which will certainly be called for we should like to see a proof of the equation $R=4\pi\sigma$, although Dr. Glazebrook (p. 63) considers the proof to be beyond the limits of the book. It is so easily done for a sphere, and the case of a plane is obtained at once by expanding the sphere of infinity. It will also be an advantage if graphical representations of the forces of charges and currents are given.

The concluding chapters deal with technical applications (there is no mention of electric lighting), with electric waves, and with the electronic theory of discharge.

The volume is very well printed, and is remarkably free from printer's errors. But in one particular we must speak with great emphasis—the punctuation requires most thorough revision. Many sentences are unintelligible on first reading, although the wording is quite correct. We give the shortest illustration of this fault. The time "will also depend on the restoring couple being less when this is big, than when it is small."

PROF. JOHANNSEN ON HEREDITY.

Ueber Erblichkeit in Populationen und in reinen Linien. Ein Beitrag zur Beleuchtung schwebender Selektionsfragen. By W. Johannsen. Pp. 68. (Jena: G. Fischer, 1903.)

PROF. JOHANNSEN has set himself a hard task, namely, the reconciliation of the views of Prof. de Vries on mutations with those of the biometric school, particularly with the Galtonian theory of regression. We say a hard task, because to perform the task of reconciliation requires, on the one hand, an intimate knowledge of the mathematical theory of statistics, and on the other a power of clearly defining the exact biological points which are at issue. It is not an easy matter to distinguish between a so-called mutation and an extremely improbable variation; indeed, the utmost caution is needed when we remember that in every case of continuous variation it has been shown theoretically that the extreme variations in populations of even many thousands must be separated by wide intervals, the wider the more extreme the variations.[1] Clearly it is practically impossible to distinguish straight off between a "mutation" and an extreme variation in the biometric sense. Both parties would probably agree that only observation of the results of propagating from the individual thus classified could serve as a criterion between the two views.

According to the biometricians, the type of the variation would regress in the offspring, either to the population mean if a "pure line" did not exist, or to the "type of the pure line" if such did exist; in the latter case a change in type from that of the "pure line" could then be produced by selective breeding within the line for a generation or two. According to de Vries, no further change could take place until a new "mutation" appears. Unfortunately, de Vries's own experiments are very far from conclusive in this respect. Thus in his experiments on clover he was not content with the discovery of a mutation, but went on stringently *selecting* year after year, in exactly the manner in which the biometrician would suggest that a "stock" should be formed from extreme variations. According to the biometrician, two or three generations of selection will form a stock which, while very variable about its type, will yet breed true, or with but small regression.

Prof. Johannsen seems to assume that this result of biometric theory (1898) is the view only of de Vries, who published his conception of the line "as perfectly constant and yet highly variable" three years later. Thus the criterion between the "Biometriker," as Johannsen calls them, and the "Mutators," as we may perhaps call their opponents, cannot be made to turn on the breeding true of "pure lines" or on the variability of such lines about their type. It can only turn on whether, within the "pure line," there exists regression and progression when we breed from variants which are not so extreme as to be at once classed by the "Mutators" as new mutations. Prof. Johannsen had a good opportunity for dealing with this problem in his experimental observations on the bean *Phaseolus vulgaris*, but he has unfortunately not provided the exact data on which it could be answered. He has shown that the population of bean *seeds*, as distinguished from bean *plants*, exhibits Galtonian regression; he may, more doubtfully, be held to have shown that "pure lines" breed true. But this is no reconciliation of the biometric and mutational theories, for both parties accept the breeding true of pure lines.

Unfortunately Prof. Johannsen seems to think that a single bean seed may be taken as typical of a plant, and thus the whole inner meaning of allowance for homotyposis escapes him. If his view—that pure lines show no internal regression—were correct, then the correlation between mother and daughter plants ought to be perfect, for either of them represents the "pure line," and that is "völlig konstant." Unfortunately Prof. Johannsen has not determined this correlation, but from his published material it can be indirectly worked out for the case of the mean weight of the beans produced by nineteen mother plants and their daughter plants. The correlation thus obtained is 0.59 ± 0.13; this might be equal to the imperfect correlation of the biometricians, who find the value for man, horse and dog to be 0.5, but it is very far from the perfect correlation needed by those who assert that there is no regression within the pure line to its own type. Prof. Johannsen's own investigation of this problem (pp. 36–37) is quite fallacious; and this is owing, we think, to inexperience in the use of statistical methods. From this standpoint we should like to protest against any such crude process of determining goodness of fit as that of placing a normal curve down on seven or eight blocks forming a "histogram," and judging the look of the fit. No such test is valid, and, further, he has not yet shown that the normal curve of errors itself is suited to describe the phenomena referred to.

We hope Prof. Johannsen will continue his experi-

[1] Francis Galton's Difference Problem (*Biometrika*, vol. i. p. 390).

ments, but at the same time in this, as in so many other cases, we hold that statistical methods cannot be safely used without proper training. Experiments of a most laborious character may be rendered nugatory because the observer has not started with a clear conception of what statistical processes he is going to employ to deduce his results, nor what observations are needful if any conclusions at all are to be reached by legitimate numerical arguments. The book shows the increasing interest in the problems of inheritance and in biometric methods; it is characterised throughout by a courtesy of tone which is very pleasing when contrasted with some recent controversial papers on heredity; but it fails, and fails badly, to prove any definite point, because the author has not clearly stated his problem, and had he done so has really not the knowledge needful to deal effectively with statistical data.

OUR BOOK SHELF.

Die europäischen Laubmoose. By George Roth. Lieferung i. Band i. Pp. 128. (Leipzig: Wilhelm Engelmann, 1903.)

THE second enlarged edition of Schimper's "Synopsis muscorum Europæorum" was published in 1876, and a list of European mosses was given by the same bryologist in "Revue bryologique" seven years later. Since that time, in this country there have appeared Hobkirk's synopsis, Braithwaite's "Moss-flora," and Dixon's handbook. In other countries there has been the same advance in bryological records, to mention only Limpricht's compilation for Germany, Austria, and Switzerland, and Husnot's "Muscologia gallica," so that the time is ripe for a new European synopsis. The work undertaken by Dr. Roth is, on the one hand, rendered easier by the existence of these authentic catalogues, but meantime the number of recorded species has increased, so that whereas Schimper enumerates 900, the author estimates European species, exclusive of Sphagna, at 1300; of these about 600 occur in Britain

The greater portion of this, the first part, is given up to a general introduction, and only the last few pages are concerned with the enumeration of genera and species. The introduction is well written, and the author has throughout emphasised the various characters which are of immediate importance for identification and classification. There is an original chapter on the part which mosses play in the economy of nature, and some account of their distribution. The system of classification adopted by the author is nearly identical with that of Schimper and Limpricht, the critical features being the separation of Archidium as a special order, and the division of the Bryineæ into cleistocarpous and stegocarpous groups; British bryologists favour Lindberg's arrangement, in which the cleistocarpous mosses are split up amongst the other natural orders.

In the essential systematic part of the book there are only a few descriptions from which to form an opinion. The author leads off with the Andreæaceæ, as the Sphagnaceæ will not be included, and he makes fifteen species for Andreæa; of these several are only accorded the rank of varieties by other authorities, *e.g.* of the fifteen, nine have been found in Britain, and yet Dixon only allows at the most five species. The various countries from which the species have been recorded should, we think, be definitely stated. Another very desirable, indeed necessary, addition is the provision of tables to determine genera, and a separate species-key to each genus. The book is liberally illustrated, but the plates are far from pleasing, and the areolation of the leaves is very doubtfully shown owing to the small scale adopted for the drawings. There are obvious advantages in using a general synopsis rather than, or in addition to, the flora of a single country, so that the book is a very desirable one, but it would be made more useful by the insertion of analytical keys and critical notes dealing with the more doubtful species. The book is to be issued in eight parts at a cost of about three pounds.

Mechanics, Molecular Physics and Heat. By Robert Andrews Millikan, Ph.D. Pp. 242; diagrams. (Boston and London: Ginn and Co., 1903.) Price 7s.

THIS book represents the first portion of a college course in general physics, in which the primary object has been to establish an immediate and vital connection between theory and experiment. It has, therefore, been made neither a laboratory manual, in the ordinary sense of the term, nor yet a simple classroom text. Each section is introduced by a theoretic statement, and is followed by instructions with regard to an experiment to be performed. As it is only a twelve weeks' course which is represented, the experiments have had to be selected out of the large number of possible ones, and in making this selection the author has aimed at having one, and only one, experiment in illustration of each principle.

For example, there is but one general principle involved in the method of mixtures, whether it be applied to the determination of the specific heat of a solid or of a liquid, the latent heat of fusion or of vaporisation; hence only one laboratory exercise is provided in illustration of the method. This extreme pruning may sometimes be necessary in an introductory course, and where circumstances render it necessary the plan of the author is no doubt excellent. But we feel sure that such an abridgment is not to be desired. A student learns so much in finding out the variations in a method which are necessary to apply it effectively to different purposes that every opportunity for the discovery ought to be afforded.

The description of the selected experiments is excellently, if somewhat briefly, made. About half the book is devoted to mechanics, which in England is usually taken in a separate course. Each chapter is concluded with a few problems having considerable merit.

We have only to suggest that in the discussion of rotation it should be clearly brought out that the moment of the forces *must* be taken either with regard to the centre of mass or to an axis fixed in space, and further that the moment of inertia is not necessarily the same in the two cases.

Ostwald's Klassiker der exakten Wissenschaften. (Leipzig: Wilhelm Engelmann; London: Williams and Norgate, 1903.)

SEVERAL additions to Prof. Ostwald's important series of reprints of classical papers lie before us. We have space to do little more than mention the titles of the individual volumes, but, in general, we cannot forbear expressing pleasure at the increased facilities they afford for a student to become familiar with original papers connected with the exact sciences. Of course, to the English student, translations into English would be more acceptable. But, given a sufficient knowledge of German, the handiness of these volumes and the valuable annotations of the respective editors are sure to prove a great attraction.

The following are brief particulars:—

No. 135.—"Theorie der Gestalt von Flussigkeiten

im Zustand des Gleichgewichts." Gauss. Translated by R. H. Weber. Edited by H. Weber. (Pp. 73, price 1.20 marks.)

No. 138.—"Über die Bewegung der Körper durch den Stoss. Uber die Centrifugalkraft." C. Huygens. Edited by F. Hausdorff. (Pp. 79, price 1.40 marks.)

No. 20.—"Abhandlung über das Licht." C. Huygens. Second Edition. Revised by A. von Oettingen. This is a translation of the famous essay in which the wave theory of light was developed and the peculiar refraction of Iceland spar was investigated. (Pp. 115, price 2.00 marks.)

No. 134.—"Experimental-Untersuchungen über Electricität." Faraday. Edited by von Oettingen. Sixteenth and seventeenth series, in which the source of the E.M.F. of a voltaic cell is investigated. (Pp. 103, price 1.60 marks.)

No. 136.—Ditto. Eighteenth and nineteenth series, describing his investigations on the development of electricity by the friction of water and vapour in other bodies, and on the relations of magnetism and light. (Pp. 58, price 1.20 marks.)

No. 21.—"Über die Wanderungen der Ionen während der Elektrolyse." Hittorf. First Part. Edited by Ostwald. Second Edition. (Pp. 115, price 1.60 marks.)

No. 137.—"Abhandlungen zur Thermodynamik chemischer Vorgänge" (1869–1881). Horstmann. Edited by van 't Hoff. (Pp. 72, price 1.20 marks.)

No. 139.—"Thermodynamische Abhandlungen über Moleculartheorie und chemische Gleichgewichte" (1867–1872). C. M. Guldberg. Translated and edited by R. Abegg. (Pp. 85, price 1.50 marks.)

The last three numbers represent treatises which are familiar by quotation to all students of physical chemistry, and ought to be welcomed in this new form.

Principii di Stereodinamica. By Gian Antonio Maggi, Professor at Pisa. Pp. 264. (Milan: Ulrico Hoepli, 1903.)

STARTING with the formulæ connecting the coordinates of a particle of a rigid body referred to axes fixed in space with its coordinates referred to axes fixed in the body, the equations of motion of a rigid body moving in three dimensions are deduced from D'Alembert's theorem. The applications include the problems of motion under no forces, in which the equations are integrated by elliptic functions, the simple and compound pendulum, motion of a billiard ball, &c., and Lagrange's equations are also treated in this part. The second part deals with Hamilton's principle in its various forms, and the third with Jacobi's theorem. The work differs in many respects from the conventional English text-books, in which special attention is given to the properties of moments of inertia and numerical examples rather than to rigorous deductions of the fundamental equations. Those whose lot it is to lecture on "three dimensional rigid" will find a study of this book very useful and suggestive. G. H. B.

The Fields of France. Little Essays in Descriptive Sociology. By Madame Mary Duclaux (A. Mary F. Robinson). Pp. vii + 318. (London: Chapman and Hall, Ltd., 1903.) Price 5s. net.

THIS little book reveals the writer's love for rural France, and her anxiety "to set down chiefly the things I have seen for myself, or which have come under my own knowledge" (p. 13), is reflected in the reality of the descriptions and in their sustained interest. Though there is little of an exciting character in the pages, readers who value word pictures of the habits and customs of country folk will find pleasure in this book.

LETTERS TO THE EDITOR.

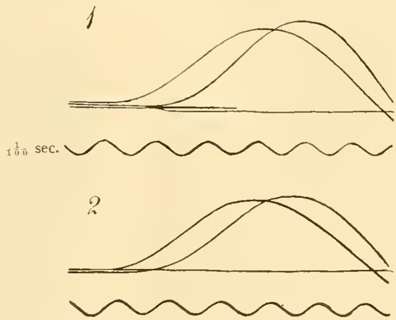
[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Velocity of a Nervous Impulse.

SIR W. GOWERS's dilemma (p. 105) is of the library rather than of the laboratory, and I should hardly care to appeal to differing book-data by different observers in evidence of an acceleration of nervous processes during the last fifteen years, either in the same or in different individuals.

I happen to possess records taken on myself in 1882 and in 1903, as well as upon my son, *aet.* fifteen, in May, 1903. In all three cases the velocity comes out at about 50 metres per second, as I read the records, but can easily be taken as indicating 60 metres if the rise of each curve from the base line is spotted a little differently. It is, in fact, advisable to examine the original data very closely before quoting velocities deduced from them, since very small differences in measurement along the abscissa multiply out to large differences of velocity expressed in metres per second.

Thus in the instances enclosed, taken from my son last May in an interregnum from Greek roots, the times, as I read them, are 0·0063 and 0·0053 sec., and the velocities 51·5 and 61·75 metres per second.



May 3, 1903.—W. W. Waller, *aet.* 15; nerve-transmission velocity; excitation above clavicle and at bend of elbow; distance = 0·325 metre. Time diff. 1, 0·0063 sec.: 2, 0·0053 sec. Velocity 1, 53 metres per sec. 2, 62 metres per sec.

The more carefully the records are taken and read the less inaccurately do the velocities come out. I think that Dr. Alcock's estimate of 66 metres per second is a somewhat closer approximation to the truth than my estimate of 50 metres, and *a fortiori* than the still lower estimate of 33·9 metres, which is that originally made by Helmholtz and Baxt in 1867. A. D. WALLER.

A Useful Empirical Formula.

THE very neat construction given by Prof. Perry in NATURE, December 3, p. 102, leads at once to the equation

$$\frac{\Delta y}{y-a} = \frac{\tan\beta}{\tan\alpha}\frac{\Delta x}{x};$$

and the assumed equation $y-a=bx^n$ gives $\dfrac{dy}{y-a}=n\dfrac{dx}{x}$

Hence, approximately, $n=\dfrac{\tan\beta}{\tan\alpha}$.

Why does Prof. Perry prefer to write

$$n=\frac{\log(1+\tan\beta)}{\log(1+\tan\alpha)},$$

which is less simple for computation?

11 Leopold Road, Ealing. J. D. EVERETT.

THE MASKED TAWAREKS.[1]

THE Tawareks, in common with other African tribes which live in the northern half of Africa, have long been an object of curiosity and interest to European scholars and travellers, but in spite of all the researches which have been made into the history of their origin and language, many problems concerning them remain unsolved to the present time. One thing about them is certain, which is that they have made their name to become a real terror among the peoples who live on the borders of their country, and although they inhabit a region which is estimated by Mr. Harding King to be as large as Russia, and are, indeed, a nation which will have to be reckoned with one day by civilised nations, no systematic attempt has been made to collect facts about and statistics of their country and its resources.

There are many theories about the origin of the Tawareks, but it is not easy to pin one's faith to any of them absolutely. They belong undoubtedly to the Berber race, and live in the wild places of the Sahara, *i.e.* the great "rocky" region which lies to the south of Algeria; they never come near civilised peoples if they can help it, and they only approach caravans belonging to other tribes in order to plunder them and to kill their owners. The track of their raids may be easily followed throughout the Sahara by means of the groups of graves and sepulchral monuments which they have scattered over the whole face of that dreary region of rock, sand, and sun, and the frequency with which such monuments are found suggests only too clearly the multitude of bloody raids which have to be laid at their door. They have one custom which distinguishes them from their neighbours, *i.e.* the men keep their faces covered by a mask, and they hide their features by these means even from the members of their own family circle.

To interview members of the Tawarek tribe and to take photographs of their faces were the chief objects which Mr. Harding King had in view when he made his journey of about six hundred miles into their country, and the volume before us, which gives a full account of his travels, is extremely interesting reading. We need not here refer to the earlier part of the book, which describes the preparations he made for his journey, for they are familiar to everyone who has tramped the desert in any part of the East, especially in northern Africa and the Sûdân, and we therefore pass on to the latter half of the narrative. The principal places which Mr. Harding King passed on his way were Saada, Bir Jeffir, Shegga, Mraier, Sidi Amran, Tougourt, Hassi, Mamar, and his travels in a southerly direction ended at Wargla; on his way back he struck off to the east at Tougourt, and, having visited Gomar El-Wad and Edemeetha, he turned to the north-west and directed his steps to Shegga, where he joined the road on which he had set out from Biskra.

[1] "A Search for the Masked Tawareks." By W. J. Harding King. Pp. viii+334; with forty-one illustrations and a map. (London: Smith, Elder and Co., 1903.) Price 12s. 6d.

Tougourt, though a most interesting place to see and examine for a short time, is not a healthy one to live in, and no one will blame a traveller for leaving it as soon as possible; it is an important market town, and possesses a mosque, of the interior of which Mr. Harding King gives an excellent view. Wargla, which marks the limit of our traveller's journey, was, and still is, a town of importance, but since the slave trade has been suppressed, and the large trading caravans from the south now dispose of their wares in Morocco and Tripoli, it has lost much of its wealth and position. The streets of Wargla are open to the sky, and the houses are well built and usually fairly well kept. There is a French fort here, in one of the walls of which is a monument to the brave men who fell in the luckless expedition of Colonel Flatters into the Sahara. The Tawareks were, of course, at the bottom of the mischief, but they were no doubt helped by the Senussi, who will, if we mistake not, give trouble in northern Africa when they find the fitting opportunity. The founder of the Senussi, Sayyid Muḥammad bin 'Ali es-Senussi, was born about 1808 at Mostaganem and died in 1859, and at the present moment his followers form one of the most powerful religious and political confederacies in northern Africa; had they joined the late Mahdi at Khartûm and supported his rebellion with troops, the result of the British expedition would have been very different.

FIG. 1.—Wargla. (From "A Search for the Masked Tawareks.")

On his return journey Mr. Harding King heard with delight that about half a dozen tents of the Tawareks were pitched near Edemeetha, for if he could but manage to get their owners to receive him

and to unveil their faces, the object of his travels would be attained. As soon as possible he set out for the Tawarek tents, and he was fortunate enough not only to be received, but to be invited to take snuff with them. He found that "they were all filthily dirty," for no true Tawarek ever washes. Such ablutions as are necessary for religious purposes are performed with sand or stone; occasionally, with the view of improving his appearance, he rubs himself with indigo. Mr. Harding King found that his hosts all had "thick, purring voices," a shifty manner, and large, lustrous, furtive eyes. By and by some of them lifted their "lithams," and so exposed the upper part of their faces, and he saw that some were white skinned, some very dark, and "their aquiline noses showed that no trace of a negro stain was present in their blood."

FIG. 2—A Tawarek Noble. (From "A Search for the Masked Tawareks.")

After a little time he was allowed to wander round their camp, and eventually succeeded in obtaining two photographs of a group of his hosts. A day or two later Mr. Harding King paid a second visit to the Tawareks, and good fortune enabled him to photograph a number of women in their tents; he found their hands small and neat, with long tapering fingers, their arms "the prettiest imaginable," their wrists "beautifully rounded," &c.; finally, the young Tawarek who was outside the tent removed his veil, and our traveller was rewarded by being allowed to take the photograph of which an excellent reproduction faces p. 315.

In a short appendix Mr. Harding King repeats a number of usually accepted statements about the Tawarek alphabet, but, naturally, contributes few new or startling facts. The Tawareks call their alphabet "Tifinagh," and they derived it from the Berbers; it may be descended from the old Libyan, but it is unlikely to be of any very great antiquity, and if it has any very close affinity with the Libyan characters on the Tugga Stone, which was set up by Atabân, the son of Yaphmatath, and which is now in the British Museum, it is not very much older, probably, than B.C. 400. Mr Harding King's narrative is very readable and modest, and is well illustrated by many good reproductions of photographs; it cannot be regarded as a scientific exposition of Tawarek lore, but it contains a great deal of knowledge collected at first hand by one who has no "axe to grind," and is therefore of value.

SIERRA LEONE.[1]

THE major portion of this work is devoted to a description of the native rising in the Sierra Leone Protectorate in 1898. Many examples are given of the hideous tortures with which the natives murdered those natives and European women and children who fell into their hands. But only those who have heard from actual word of mouth of those who had been through the insurrection can fully realise the hellish cruelty of the native. These chapters should be read by those who forget or do not know of what diabolical acts the native is capable. They should be remembered by those who nowadays urge us to "take the native with us" in our reforms. Justice to the native the Englishman will always measure out, but it will be long before the native can be treated as our social, intellectual, or moral equal. While we must not forget these terrible traits in the native character, we may yet do full justice to his many admirable points, and Captain Wallis's tribute to the men of the native frontier force who remained loyal throughout the rising is nobly deserved. It is well, too, that a book of this kind should have been written, recording, as it does, individual acts of bravery and heroic defences under the terrible conditions of the West African climate.

The portion of the book that will perhaps most interest the general reader will be the account of the secret societies, "the Alligator," "the Leopard," and others still, as Captain Wallis admits, existing, but yet much curtailed in their devilish operations. So much is here recorded of them that it would appear certain that the whole origin, meaning, and ramifications of these societies could be unravelled by a careful investigator with time and money at his disposal. "Sāss stick," the *mwavi* of British Central Africa, is still used in the protectorate, and we well remember the long journey made by us into the bush in search of the tree, which we found almost completely denuded of bark, showing that it was much in use. As the author points out, the subject of native medicine is still neglected, and although there are botanical gardens at Freetown and Songo, Aburi (Gold Coast) and at Lagos, we should be surprised to learn that any contribution to this subject ever came out of them.

[1] "The Advance of Our West African Empire." By C. Braithwaite Wallis. Pp. xv+318. (London: Fisher Unwin, 1903.) Price 21s.

In a chapter devoted to "our commercial policy," the native arts are considered, such as pottery and the weaving of cloths. The production of these should, in our opinion, receive all encouragement and careful direction before the trading companies have "improved" them out of existence with their cheap Manchester substitutes. Very wise, too, is Captain Wallis's advice that native customs and traditions should be cherished, except in so far as they manifestly clash with the higher ideals of Christian morality. The question of health can hardly be avoided in a book on West Africa, and the author is to be congratulated on having grasped the main facts of the mosquito malarial cycle. He is aware of the danger of camping in a native village—the almost invariable practice—for, broadly speaking, it is here only that the malarial mosquito is dangerous, because it has been infected with parasites by the native children, who form, so to speak, the great central depôts of malarial parasites in Africa. In a word, the first law of health in West Africa is efficient protection from this constant source of malarial fever, and a bungalow well isolated from native huts would mean many a European life saved. Our illustration of Government House, Bandajuma, on the contrary, shows things as they should not be. Those "deadly" huts (seen in the right-hand corner) mean constant danger to the European commissioner.

FIG. 1.—Government House, Bandajuma. (From "The Advance of Our West African Empire.")

The book is fully illustrated, but we think many of the illustrations might have been chosen with greater care. They give but little idea of the characteristic scenery of the country. Thus we sought in vain for the magnificent cotton trees or the beautiful unmatched "lines" of the mangrove tree. We think, too, the title is too comprehensive for the nature of the book. But the author deserves our thanks for having given us a straightforward account of the rebellion and some very interesting chapters on native customs. We have read the book with much pleasure, and in our own case with an added pleasure from familiarity with many of the scenes and faces represented in the illustrations. J. W. W. S.

THE IONISATION OF ATMOSPHERIC AIR.

MESSRS. ELSTER AND GEITEL have published an important paper in the *Physikalische Zeitschrift* (No. 9, pp. 522–530), "Ueber die radioaktive Emanation in der atmosphärischen Luft." They find that the abnormal conducting power of the stagnant air of cellars and caves, and the amount of induced radio-activity which can be obtained from such air upon a negatively charged rod suspended in it vary greatly in different regions. In some places such air is no more active than ordinary atmospheric air. Air sucked through a pipe of which one end is buried in the ground is generally active, like the air of most cellars and caves; tests of the activity of samples of such ground-air from different localities showed great variations, some being no more active than ordinary air. The activity of ground-air falls off at a rate comparable with the rate of decay of the radium emanation. If a portion of the soil of a region in which the ground-air is radio-active is isolated, it gives to a volume of air in contact with it abnormal conductivity which reaches its maximum in a few days. The soil retains this power for many months at least. The phenomena are all most readily explained by supposing that substances, which have the power of producing a radio-active emanation like that of radium, are distributed in varying amount among the materials composing the soils of different regions. In the latter part of the paper is an account of some interesting observations on the dependence of the radio-activity of atmospheric air upon meteorological conditions. The increase of the activity of the air which generally accompanies a fall of the barometer is attributed to the escape of ground-air into the atmosphere.

Herr Himstedt repeated and confirmed some of Messrs. Elster and Geitel's experiments upon ground-air (*Berichte* der naturforschenden Gesellschaft zu Freiburg, vol. xiii. p. 101). In the course of this work he found that air passed through a water air-pump acquires considerable conducting power, which persists (even when the air is dried and filtered after passing through the pump) for some days. He appears to have been unaware of the previous discovery of this phenomenon by Prof. J. J. Thomson. Himstedt gets identical results from distilled water, rain-water, and tap-water, whereas Thomson found distilled water and rain-water comparatively ineffective, the action being strongest with certain waters from deep wells, and being attributed by him to a radio-active substance contained in such water. Himstedt found, as Prof. Thomson had previously shown, that the activity of the air is not removed by an electric field; he proved, however, that it can be removed by passing through a tube cooled by liquid air. He believes that water brought into intimate contact with a gas exerts an ionising action upon it.

In the *Actes* de la Société helvetique des Sciences naturelles (85me session 1902 à Genève), Prof. H. Ebert gives an account of the progress which has been made towards an explanation of the phenomena of atmospheric electricity on the "Elektronentheorie." He mentions some of the results of measurements,

made with his aspiration apparatus and by other methods, of the number of positive and negative ions present in atmospheric air under different conditions. The variations in the richness in ions of the air at different heights (studied by means of balloon observations) and the excess of positive ions in the air carried down by the Föhn are of special interest. The electrical phenomena accompanying precipitation are explained by the difference in the efficiency as condensation nuclei of the positive and negative ions. An attempt is made to treat this part of the subject quantitatively. The maintenance of the ordinary fine weather electric field is put down to the difference between the positive and negative ionic velocities.

Prof. J. A. McClelland has described in the Royal Dublin Society's *Transactions* (November) experiments upon ionisation in atmospheric air. These experiments are introductory to a study of the number of ions in the free air of the atmosphere under varying meteorological conditions. Like Prof. Ebert, he has obtained evidence from the results of preliminary experiments of a larger number of ions per c.c. of free atmospheric air than was shown by Prof. Rutherford's measurements in Canada. The latter found on some occasions no more ions per c.c. of the free air than are generally produced *per second* in each c.c. in air in closed vessels, whereas Prof. Ebert's results are more nearly what we should expect if the rate of production of ions in the free air were the same as in a closed vessel.

MEDICAL REPORT OF THE LOCAL GOVERNMENT BOARD.[1]

THE annual report issued by the Medical Department of the Local Government Board always contains matter of interest. The first half of the volume comprises an excellent summary of the contents by Dr. Power, the able head of the department, the vaccination and other statistics, and the reports of inquiries into the sanitary administration of various districts, of outbreaks of epidemic disease, and on the distribution of plague and cholera. There is a mass of information in these pages of the greatest value to the specialist.

But to the readers of NATURE the reports of the auxiliary scientific investigations carried out for the Board will prove of most interest. Dr. Klein is responsible for four of these :—(1) On the nature of the Haffkine plague prophylactic; (2) on the phenomenon of agglutination; (3) on the micro-pathology of hæmorrhagic small-pox; and (4) on the differentiation of the *Bacillus enteritidis sporogenes, B. butyricus*, and *B. cadaveris sporogenes* from one another. The cultural and other differences between these microbes are detailed, and may prove very useful in the bacteriological examination of potable waters. The *Bacillus aërogenes capsulatus* is here alluded to, but that is all. This organism is closely allied to, if not identical with, the *B. enteritidis sporogenes*, and it is hardly right that the work of the Americans in this connection should be dismissed in so summary a fashion.

Dr. Sidney Martin has once more taken up the investigation of the chemical pathology of infective diseases, dealing in this paper with the products of the *B. dysenteriae*. Experiments were performed in order to ascertain whether any toxic substance is produced when the bacillus is grown in fluid media. Indications of the presence of such a soluble toxin, proteid in nature, were obtained, but are not convincing, as no control experiments are mentioned; the most potent poison is certainly contained in the bacterial cells themselves.

Dr. Gordon contributes a useful paper on certain diphtheria-like organisms, and Dr. Houston reports on the inoculation of soil with sewage and on the examination of Chichester well water. Dr. Haldane gives further details of his method for destroying rats on shipboard with carbon monoxide, but this does not seem to be so convenient and safe as the Clayton process with sulphur dioxide.

The reports from the Board's vaccine department are of considerable interest. Nearly 1,000,000 charges of glycerinated calf lymph were supplied from the Board's laboratories during the year under review, and proved to be of excellent quality. Dr. Blaxall gives an account of an outbreak of equine variola, Mr. Fremlin describes a useful method for anaërobic cultivation, and Dr. Green discusses the action of various alcohols and other substances upon vaccine lymph. The volume is illustrated with several excellent photomicrographs.

R. T. HEWLETT.

[1] Thirty-first Annual Report of the Local Government Board, 1901–2. Supplement containing the Report of the Medical Officer for 1901–2. Price 6s. 9d.

HERBERT SPENCER.

BY the death of Herbert Spencer England has lost the most widely celebrated and influential of her sons. He has passed away in the fulness of years and honours, having lived to complete the great work that he designed and took in hand half a century ago. Spencer was not without honour in his own country, yet our national indifference to philosophy and to all systematic thinking, and the subserviency of a great part of our professed philosophers to the great German metaphysicians, have undoubtedly prevented his receiving from his countrymen during his lifetime the full measure of recognition that is due to his splendid services to science and philosophy. And, indeed, the enthusiastic and unstinted eulogy of our great dead, voiced by the Press of every civilised country during the past week, has brought home to many of us for the first time the greatness of the man who by sheer force of intellect and character has won the tribute of the world. For in Spencer's work there was nothing designed to attract the attention of the crowd, there was no attempt to write down to the level of the multitude; it was one long and steady effort of a great intellect systematically grappling with the great problems. Yet his books have been translated into a score of languages, have been studied by hundreds of thousands of serious men, and in no small number of them have aroused admiring and enthusiastic gratitude.

Spencer's system of philosophy was broadly distinguished from other latter-day systems, save in a measure from that of Comte, by two features; firstly, his conception of philosophy as the unification of the sciences; secondly, the evolutionary standpoint from which he sought to effect that unification. While the great metaphysicians have for the most part set out with the premise that the world must be intelligible to our minds, and have held it to be their business to present it as an intelligible whole, Spencer prefaced his system of philosophy with a demonstration of the irresolvable mystery that lies behind us and before, and sought merely to discover the most general laws or statements that will express the relations of all the phenomena that science has revealed. That towards this great work he has made splendid and enduring contributions no one will deny. That there remain great gaps in his system is equally undeniable, and the most serious charge that can be made against him is that he professed, or seemed to profess, to have bridged the chasm between the inorganic and the organic worlds, between the world of mechanism and the world of volition.

When Spencer is compared with other great thinkers, he stands distinguished by the immense range of his knowledge of the facts and principles of the sciences and by that wonderful power of generalising their laws which was the instrument by means of which he sought to unify them in one grand scheme of thought. It is true that the specialist may discover shortcomings in his treatment of each one of those sciences, not less in the psychology, in which he is acknowledged as a master both of principles and of details, than in his biology and sociology; and it is true that certain of his great generalisations, for example, the ancestral-ghost-theory of the origin of religions, cannot now be regarded as well founded. Nevertheless, he has contributed to each of these sciences a wealth of illuminating and suggestive ideas, and even those of his hypotheses that have proved untenable have done so great service in provoking thought and discussion that, had he given to the world these unsuccessful suggestions only, he would still have had a great claim upon our gratitude.

On contemplating the completed System of Synthetic Philosophy there is a certain pathos in the fact that the final volumes, to which Spencer had long looked forward as the consummation and crown of his life's labour, namely, those setting forth the principles of ethics, are perhaps generally felt to be the least convincing part of the whole, a feeling which, it can hardly be doubted, was shared by the great thinker himself. But, whatever may be the final verdict as to the value of Spencer's ethical philosophy, there can be no difference of opinion as to the great moral value of his own life. He gave us an example, all too rare and too sorely needed in these days, of a life strenuously devoted through all the years of maturity and age to the realisation of a great object, the spectacle of a man working on with steadfast purpose, unmoved alike by the neglect and by the acclamation of the world, "Voyaging through strange seas of thought, alone" towards the lofty heights of Thought whose dim and cloud-capped towers had caught and fixed his eager youthful gaze.

Spencer's writings may seem to some readers cold and lacking in emotional fervour, and the man himself a little wanting in human sympathies; but can it be doubted that so grand an effort was sustained throughout the arduous years by a deep feeling for the mystery and pathos of the life of man, that tiny organism endowed with the capacity for thought and set to wonder, to labour, and to hope among the spheres that roll for ever through infinite space?

If it could be ascertained what parts of all Spencer's work do, and will, appeal most deeply to great numbers of thinking men, they would probably be found to be, firstly, the demonstration of the Unknowable Mystery that must for ever elude our grasp as the bounds of knowledge are thrown ever wider and wider, and secondly, the doctrine of Transfigured Realism that gives to the mind, painfully halting between the vain imaginings of the pure idealists and the shallow teachings of the materialists, a firm and sane standing-ground from which to view the two great orders of being, the internal and the external worlds.

Much of Spencer's way of thinking and many of his ideas have become a part of the very atmosphere we breathe and cannot but accept, and much of his work must form a part of every future system of philosophy that shall attempt the unification of the sciences. His fame is secure, for posterity can never forget that in an age in which men's minds were oppressed, and in danger of being overwhelmed, by the rapidly growing wealth and complexity of their knowledge of the phenomenal world, Spencer generalised boldly and effectively, breathing life into the dead bones of science.

NOTES.

THREE Nobel prizes for science have been awarded as follows:—for physics, Prof. Henri Becquerel divided with M. and Mme. Curie; for chemistry, Prof. Arrhenius; and for medicine, Prof. Finsen. The formal distribution of the prizes took place on Thursday, December 10, in the presence of the King of Sweden and several members of the Royal family and a distinguished gathering. It is announced that Prof. Finsen has decided to give 50,000 kroner (2753*l*.) from the amount awarded to him to the Phototherapeutic Institute at Copenhagen, and that two members of the governing body will each present it with a like sum.

MR. BRUCE, the leader of the Scottish Antarctic Expedition, which was sent out last year on board the *Scotia*, has arrived at Montevideo from the Falkland Islands. He reports that all is well on the *Scotia*, which is on the way to Buenos Ayres. Six men have been left behind in charge of a meteorological station. The meteorological station referred to is evidently the station set up by Mr. Bruce at Cape Pembroke, Falkland Islands, before the *Scotia* left for the southern seas in January last.

IT is announced that Dr. Oscar Guttmann has presented to the Chemical Society a photograph of the portrait of Roger Bacon in possession of Lord Sackville at Knole House, Sevenoaks.

DR. HANS GADOW, F.R.S., has, we learn from *Science*, accepted an invitation of the Lowell Institute, Boston, to give a course of six lectures, beginning March 29, 1904, on "Coloration of Amphibians and Reptiles." Dr. Gadow will probably give other popular lectures on zoological subjects while he is in America.

IT is reported in *La Nature* that Baron Edmond de Rothschild has sent 20,000 francs to M. Albert Gaudry, president of the Paris Academy of Sciences, to make it possible for the Museum of Palæontology to secure the very precious specimens of the Filhol collection which were obtained from the Quercy phosphate beds.

ON November 28 about three hundred teachers met at New York to form an Association of Teachers of Mathematics in the Middle States and Maryland, the prime object of which is the improvement of mathematical teaching. Prof. David Smith, of the Teachers' College, was elected president of the Association; Prof. H. B. Fine, of Princeton University, vice-president; and Dr. Arthur Schultze, of the New York High School of Commerce, secretary. After President Butler, of Columbia University, had delivered the address of welcome, papers on various aspects of mathematical teaching were read by Mr. Harry English, of Washington, D.C., Mr. Isaac N. Failor, of Richmond Hill, Dr. Arthur Schultze, and Mr. J. L. Patterson, of Philadelphia. The next meeting of the Association will be held at Columbia University, New York City, about next Easter, and applications for membership and other communications may be addressed to Dr. Schultze, No. 4 West 91st Street, New York City.

HIS MAJESTY THE KING has presented a fine stag to the University College of North Wales for its zoological museum. The animal has been specially selected for the college collection, and will illustrate fully the characters of the red deer. Prof. White has had the stag sent to Mr. Edward Gerrard, of Camden Town, to be mounted. The following gifts have reached the college during the past few weeks:—Mr. Assheton-Smith, specimens of the guanaco, St Kilda sheep, Australian swan, goshawk, grouse, and rhea; Mr. Herbert C. Hodson and Mr. James M. Reid,

bloodhounds; Dr. Corbet W. Owen, nests of the African weaver bird; Mr. Hugh O. Hughes, specimen of guano from the Chincha Islands; Mr. H. S. Forrest, small collection of fishes, &c.; Mr. J. Pugh, a fine pike; the Rev. W. S. White, small collection of bird and bat skins. Prof. White has also received a second gift of 10*l*. from Mr. Henry R. Davies for the zoological museum.

THE annual dinner of the Institute of Chemistry was held on Monday night, with Mr. David Howard, the president, in the chair. The president, in responding to the toast of the Institute, proposed by Lord Justice Cozens Hardy, remarked that the application of chemistry in our industries was a national question. Most of the successful manufacturers in Germany whom he knew were doctors of philosophy and very well educated men, who had, in addition, devoted their lives to the study of every detail of their work. It must be realised in England that the technical chemist should be at least as well educated and thoughtful as his German friends. The Institute was now considering what could be done to direct the studies of men engaged in technical work, for, while his general training must not be diminished, a technical chemist could not have too high a scientific training. Mr. Haldane proposed the toast of "Prosperity to Science and to Scientific Industries." He remarked that as a nation we needed science. It was not that we were going back; the general average was higher than ever before, and it behoved us to see that we kept our place. We needed science in our Government, in our industries, in our education. The time, then, had surely come when more science should be instilled into national methods. Why should not the grants to the university colleges, and to colleges giving scientific teaching of a university type, be increased? Any Government would be glad to do that if it felt that there was something like organised public opinion at its back. Then we suffered in England from a want of enthusiasm for science on the part of our manufacturers, and little progress could be made until this was remedied.

A PAPER, entitled "The Metrical System of Weights and Measures," was read by Mr. Alex. Siemens at the Royal Statistical Society on Tuesday. The author expressed his conviction that, though scientific men had for some time previously been discussing the subject in a general way, there is little doubt that the present metrical system is the result of the agitation of James Watt, who took the subject up in the year 1783. The history of the question in this country was traced from the year 1824, when Parliament was first approached on the subject. Last year the Liverpool Cotton Association effected the change from the binary to the decimal system of quotation, and Mr. Siemens showed how practically useful the 2000 lb. ton and other forms of reckoning on the decimal system had proved in the United States and Canada, as, indeed, in many British dependencies. In France the metric system was not really legal to the exclusion of every other until January 1, 1840, that is to say, a little more than sixty years ago. To-day only one system of measures exists in that country, and it is absolutely incorrect to say that the old measures are still employed there; even their values are becoming more unknown. The only notable exception is to be found in those industries or trades in which foreign nations which have not adopted the metric system have such a preponderating influence as to, thus far, impose the use of their own measures. Even in Germany, where the metric system has been in use not much more than half as long as it has been in France, though a few old names of weights and measures are in use, they really denote metrical measures, and may be treated as local expressions only. As regards the expense of the change, Mr. Siemens denied the suggestion that our engineering machinery for screw cutting would have to be scrapped—all that would be necessary would be to buy suitable exchange wheels. The author finally expressed his opinion that not only our own dependencies, but other nations would follow our lead if we made the change, and that thus international unity of weights and measures would at once become an accomplished fact.

THE Bradshaw lecture was delivered before the Royal College of Surgeons on December 9 by Mr. Henry Morris, the subject being "Cancer and its Origin." An admirable survey of the various theories of the nature of cancer is given, such as the "lost balance theory" of Thiersch, adopted by some recent writers, *e.g.* Foulerton, the "tumour-germ theory" of Cohnheim, and the various parasitic theories. Mr. Morris does not look with favour upon the parasitic theories; he says, "neither fission fungus, yeast fungus, nor psorosperm—neither bacterium, blastomycete, nor protozoon—has up to the present moment been satisfactorily shown, in spite of years of patient study by many skilled workers, to be in any sort of causal relation to the disease." He believes that there is "one theory which is more consistent than any other with all that we know about malignant disease, which fully explains the origin of very many non-malignant tumours," this being Cohnheim's "tumour-germ theory," which states that tumours originate from a matrix of embryonic cells which during fœtal life are cut off from their proper connections. Mr. Morris discusses the evidence for and against this theory, and the practical outcome should it be proved to be true.

ANOTHER example of the practical utility of wireless telegraphy at sea was afforded the other day as a result of the accident which happened to the *Kroonland* on her way from Antwerp to New York. The steamer disabled her steering gear when west of the Fastnet and was obliged in consequence to abandon her journey. Not only was the captain able to communicate particulars of the accident at once to the agents of the American line at Antwerp and to receive (in less than an hour and a half) instructions as to how to proceed, but the passengers were enabled to send messages to their friends and relatives assuring them of their safety. A large number of passengers made use of the wireless telegraphy installation, some telegraphing for more money, which was wired to them per the purser. The wireless installation on the *Saxonia* was useful in another way a short time back; getting into communication with the *Campania*, the latter informed the *Saxonia* that berths were waiting for English-speaking emigrants as motor-men on the surface lines of New York. These two instances serve to show the benefits that wireless telegraphy confers on travellers by sea.

THE fourth report of the National Electric Light Association's committee for the photometry of arc lamps contains some interesting results of measurements of the light distribution and mean spherical candle-power of the American pattern Nernst lamps. These lamps are made with one, three, six or more glowers in parallel; the measurements of the committee were made on the first three of these types. They show that the light distribution below the horizontal is very good, but above it is very poor. The distribution in the horizontal plane is fair; thus with the six-glower lamp the maximum horizontal candle-power is 112, the minimum only about 40 candles; the mean horizontal candle-power is 85 candles. For the same lamp the

mean spherical candle-power is approximately 170 candles, and the mean hemispherical candle-power for the lower hemisphere 290 candles. The maximum candle-power is 400 candles in a direction vertically downwards. It will therefore be seen that the efficiency varies very greatly according to the direction in which the candle-power is measured. Taking the mean spherical candle-power, which is the only value of any use for comparative measurements, the consumption of power comes out to 3·3 watts per candle; for the mean hemispherical it is 1·9, and for the mean horizontal 6·6 watts per candle. If, however, the measurement be made in the direction of maximum candle-power, the consumption of power is only 1·3 watts per candle. The general distribution of the light and the values of the mean and maximum candle-powers show that this lamp is on a par with a small (six to eight ampere) arc as a source of illumination.

We have received further copies of the *Journal* of the Meteorological Society of Japan (for September and October last), containing papers on the climatology of Formosa and other important subjects relating chiefly to Japanese meteorology. The articles are all in Japanese, but the promise of issuing some in European languages is reiterated. We look forward with pleasure to the fulfilment of the promise, as the proceedings of this energetic society will doubtless be of much interest to our readers.

The weather for the present month is proving very disappointing, and, after a few days with somewhat low temperatures at the commencement, the conditions have again become cyclonic with the usually accompanying mild and damp south-westerly winds blowing from off the relatively warm waters of the Atlantic. Disturbances are again reaching us with considerable frequency, and the rains which are occurring over the whole country are considerably augmenting the already excessive falls for the present year. At Greenwich the fall for 1903 is now approximately 35 inches, and is about an inch in excess of any previous annual record during the last sixty years. The storm areas which have arrived over us recently have had the barometer as low as 29 inches, and gales have been experienced at many places in exposed positions on our coasts.

A correspondent sends us an extract from a letter describing an aurora observed at Calgary, Canada, on October 31, when auroral displays were seen in many parts of the world (see this vol. p. 9). At Calgary a peculiar light was noticed in the sky about 6.30 p.m. Large and beautiful vertical shafts of coloured light were first seen moving about the sky. "Presently the shafts began to lower, vastly increased in size and number, until their lower tips touched the ground (objects about half a mile off could be seen through them) and the upper tips met in the zenith, losing themselves among the stars directly overhead. They formed a perfect apse, bright ruby above, and coming through purple and greenish tints to gold at the bottom. The apse shivered and shook out all sorts of colours, and literally chased me in the buggy, the nearer huge shafts being but a few yards off. A horse in a field alongside tore madly round in terror. A few minutes later there were only a few stray but grand shafts left."

Some experiments on the influence of a magnetic field on a tuning fork are described by Mr. O. Kirstein in the *Physikalische Zeitschrift*, and lead to the results that if the lines of force are perpendicular to the plane the frequency is increased; if parallel it is diminished; at an angle of 45° no change occurs; the decrease in the second case is greater than the increase in the first; the changes are in every case proportional to the field, and the action of the magnetism is only temporary. These results, some of which agree with previous investigations, have an important practical application in connection with electrically excited tuning forks.

The frequent use of silk suspension fibres in physical laboratories renders the determination of the elastic constants of silk a problem of considerable interest. This problem forms the subject of a paper by M. F. Beaulard in the *Journal de Physique*, in which hysteresis curves are drawn showing the elongations produced by traction. The most remarkable conclusions drawn are, firstly, that the curve ultimately tends to become a straight line, the hysteresis then vanishing; and, secondly, that the value of Poisson's ratio, calculated from observations of the behaviour of the fibre under traction and torsion, is about 1·56, and this high value supports the view that silk is not isotropic.

A graceful tribute to the venerable Japanese botanist, Ito Keisuki, is paid by Mr. Botting Hemsley by the establishment of a new genus of the Bixineæ under the name Itoa. Dr. Tokutaro Ito, who is associated with his grandfather in the compliment, has followed in the paths of his illustrious ancestor in his systematic contribution entitled "Plantæ Sinenses Yoshianæ."

In 1894 Prof. Carmody published a summary of the industrial resources of the island of Trinidad, and in a small pamphlet recently issued he uses this as a basis of comparison with the conditions and general trade returns of the island for the year 1902–3. The principal export, sugar and sugar products, has, of course, decreased considerably, but there is a balancing increase in the amount of cacao. Another important product is that of asphalt, which has also steadily increased in amount. A striking feature of the statistics is the rising value of imports from Canada.

The Barbados *Agricultural Reporter* of November 18 contains a report of a meeting of the Legislative Council of the island at which it was resolved to offer rewards for the destruction of mongooses. With this, it may be hoped, we shall soon hear the last of an ill-starred experiment in acclimatisation.

A circular has recently been issued by Messrs. Stejneger and Miller, the well-known American naturalists, urging the governing body of the Carnegie Institution to undertake a thorough and detailed biological survey of the eastern Holarctic region, on the plan followed by Dr. C. H. Merriam in the United States. Despite the gigantic nature of this undertaking, it is estimated that it might be completed within ten years.

Among several other articles in the *Journal* of the Quekett Microscopical Club for November, we may refer to one by Mr. W. H. Harris on the emission of musical notes by the hover-flies of the genus Eristalis, and on the habit from which they take their name. It appears that the thoracic spiracles of these insects carry a couple of crescentic chitinous rods joined by a ligament, so as to form a bow. A large bundle of muscles is attached to these rods, which supports a number of delicate membranes pleated in a complex manner. The air-chamber is kept inflated by the movements of the fly, and the musical notes are apparently produced by bringing the pleated edges of the membranes close together and expelling, by muscular action, the air from the chamber with sufficient force to set them vibrating.

We have received from Mr. E. B. Waggett a communication with reference to a proposed method of graphically indicating the duration of the residence in the British Islands of the various members of the bird-fauna. On a sheet of ruled paper two large dots, an inch apart, are marked on four of the ruled lines, the dot on the left indicating New Year's Day, and the one on the right December 31. In the case of permanent residents, the two dots are connected by a line. Winter visitors are indicated by drawing a line half an inch long on each side of the right dot, the extremities of these lines being marked above by arrow-heads, of which the one on the left points downwards, to indicate a southern migration, while that on the right points in the opposite direction, and thus implies a northern flight. Summer visitors, on the other hand, are indicated by a half-inch line midway between the two dots, with arrows on the lower side of the extremities, the direction of which indicates the migration. Species which merely rest for a short time in Great Britain during the spring and autumn migrations are indicated by drawing two quarter-inch lines some distance on each side of the right dot, with an arrow both above and below each to mark the direction of the migration. Modifications of these may be easily drawn to indicate residents which build twice, or even thrice, in a season, and also resident species building in the spring which are reinforced in autumn by migrants from the north for the winter season.

In the January number of the *Psychological Review* the tenth anniversary of the journal will be celebrated by the founding of a special literary section, to be published monthly, in which fresh, prompt treatment will be given to the literature of psychology, philosophy, and cognate subjects.

Messrs. J. and A. Churchill have now published separately the second part of "Elementary Practical Chemistry," by Dr. Frank Clowes and Mr. J. B. Coleman. The present publication is divided into three sections, dealing respectively with qualitative, volumetric, and gravimetric analysis.

The Huxley lecture for 1903, by Prof. Karl Pearson, F.R.S., "On the Inheritance of the Mental and Moral Characters in Man, and its Comparison with the Inheritance of the Physical Characters," has now been published separately by the Anthropological Institute. It will be remembered that we published an abstract of Prof. Pearson's lecture in our issue for October 22.

Mr. W. C. Fletcher, head master of the Liverpool Institute, has been appointed to the newly-established post of chief inspector of secondary schools. Mr. C. A. Buckmaster, acting senior chief inspector at South Kensington, has been appointed chief inspector of schools under the branch of the Board of Education which deals with evening schools, technology, and higher education in science and art.

The fourth volume of the "*Knowledge* Diary and Scientific Handbook" has now been published, and in this 1904 issue there is much information which will prove of use to men of science. Among many interesting contents may be noticed the numerous practical articles, which include one by Mr. William Marriott on practical meteorology, and one by Mr. Edwin Edser on the optical constants of lens combinations. The tables, too, are abundant and well selected.

We have received a copy of Prof. Robert Wallace's opening lecture of the session on October 13 to the students of the department of agriculture and rural economy at the University of Edinburgh. The lecture is entitled "Agriculture, Live Stock, and Dairying in Argentina," and deals with Prof. Wallace's observations and inquiries during his recent six months' tour in South America. The booklet is published by Messrs. Oliver and Boyd at ninepence.

The issue of "Who's Who" for 1904 contains above one hundred and fifty pages more than that for 1903, and the increase in size indicates the large number of additional biographies now included. The notable persons whose biographies are given are not exclusively British, for particulars are provided also of American men and women of eminence. Messrs. A. and C. Black are to be congratulated upon the general appearance of the book, and the editor upon the excellence of its arrangement. The price of the 1904 edition is 7*s*. 6*d*. net.

Many of our readers are acquainted with those excellent volumes of "Photograms" (Messrs. Dawbarn and Ward, Ltd., London) which have appeared yearly since 1895. The issue for the present year surpasses, if possible, the high standard which this publication had reached, and our photographic readers will find in these pages much that will be of interest. As a pictorial and literary record of the artistic photographic work of the year the compilers and publishers are to be congratulated, for the volume is high-class in every respect.

The first number, that for November, of the *Central*, a magazine edited on behalf of the City and Guilds of London Central Technical College Old Students' Association by Dr. E. F. Armstrong and Mr. Maurice Solomon, is an excellent performance. It is attractively produced, well illustrated, and interestingly written. There is an instructive article on oscillographs by Mr. Solomon, a description of the new electrical laboratories by Mr. Joseph Griffin, and an unusually large number of notes concerning the work and doings of old students; one section of these notes, dealing with chemical research, is conclusive evidence that the atmosphere of the Central Technical College is favourable for the development of investigators; and the new magazine shows that literary as well as scientific enterprise is encouraged.

In a paper read recently before the Church Society for the Promotion of Kindness to Animals, the Hon. Chas. S. Rolls remarked that at the present time those who were seeking to develop motors and motoring were experiencing exactly the same opposition from many rural communities as the promoters of railways met with earlier. Having disposed of many thoughtless and amusing objections brought against motor vehicles by opponents, he remarked that, as regards other objections, it should be remembered that the difficulties of noise, vibration, smell, and untrustworthiness must eventually be, and are rapidly being, overcome. This country has, said Mr. Rolls, been infested with a host of inferior cars, consequently these objections have been more apparent here than they are on the Continent or in America. The introduction of the motor-car will, undoubtedly, constitute the means of better intercommunication, which has always been the chief factor of civilisation. It will result, too, in the decrease of wear and tear on the roads, greater economy of space in the streets, and especially a greatly increased cleanliness of the latter.

The additions to the Zoological Society's Gardens during the past week include a Brown Capuchin (*Cebus fatuellus*) from Guiana, presented by Mr. F. J. Holmes; two Tantalus Monkeys (*Cercopithecus tantalus*) from West Africa, a Globose Curassow (*Crax globicera*) from Central America, two Brazilian Tanagers (*Ramphocoelus brasilius*) from Brazil, a Tytler's Parrakeet (*Palaeornis tytleri*) from the Andaman Islands, deposited.

OUR ASTRONOMICAL COLUMN.

THE TOTAL SOLAR ECLIPSE OF MAY, 1900.—The report of the expedition organised by a joint committee of the Royal Dublin Society and the Royal Irish Academy to observe the total solar eclipse of May, 1900, has just been published in vol. viii. (series ii.) of the *Scientific Transactions* of the Royal Dublin Society.

The instruments used were chiefly lent by Sir Howard Grubb and Mr. W. E. Wilson, F.R.S., who, with Prof. Joly, Dr. A. A. Rambaut and others, were members of the expedition. They included two cœlostats and two coronagraphs, one of the latter being of 4 inches aperture and 19 feet 4 inches focal length, the other of 6 inches aperture and 7 feet 10½ inches focal length; a special spectroscopic apparatus for securing a continuous series of photographs of the spectrum of the chromosphere was also taken. The second of the two coronagraphs was used with a coloured screen, made by "fixing" an ordinary unexposed film, and then soaking it in a bath of tartrazine, which allowed only the green light about the chief coronal radiation to be photographed. The resulting negative, which was exposed for eighty seconds, shows considerable extension of the outer corona, although the spectroscopic observations indicated that the green corona line was very faint during this eclipse.

The spectra were obtained with a kinematograph especially designed by Sir Howard Grubb to take twelve plates at the second and twelve at the third contact, in such a manner that no interval occurred between two successive exposures, the idea being to observe whether all the bright lines appeared or disappeared simultaneously, or whether some became reversed earlier than others as would be expected if their respective absorptions took place at different levels. It was found that the lines generally disappeared in the order of brightness shown on the original spectrum, although there were several exceptions to this rule, notably the strontium lines at λ 4078 and λ 4216, which disappeared earlier than other lines of the same original intensity. These differences are shown in the analytical table which accompanies Dr. Rambaut's discussion of the spectra. The wave-lengths and origins given in this table seem less determinate than those which have been previously published by other observers. Several plates showing reproductions of the corona photographs, which have been discussed by Mr. Wesley, and of the spectra are given at the end of the paper.

CLOUDS ON MARS.—An article by Mr. Denning, published in the December number of the *Bulletin* de la Société astronomique de France, records the appearance of cloud-like formations on Mars during the latter half of May. On May 19 and 21 the Syrtis Major was dark and sharply defined, but on the latter date a brilliant region appeared over its southern extremity, whilst on May 23 this region was very faint and ill-defined, although other features usually less obvious were plainly seen. Mr. Denning describes the region as appearing to be covered by strongly reflecting vapours which were not dense enough to hide completely the surface, but were sufficiently dense to give it a more luminous and less definite appearance. On May 25 and 27 a luminous zone was observed to the north of the Mare Cimmerium, and during the latter part of the month an extensive luminous band was visible along the northern edge of this sea, Syrtis Major, and the Linus Sabæus. It seems probable to Mr. Denning that the clouds of white vapour which were observed on the eastern edge, south of Syrtis Major, on May 21 travelled very rapidly in a northern direction, and thus caused the lack of definition observed in the above regions on the later dates, and he connects this phenomenon with the appearance of a white projection observed by Mr. Lowell, at Flagstaff, on May 26.

Several other remarkable phenomena, notably a marked division of Nilus by a bright spot, which extended far to the south-east from the eastern edge of the Lunæ Lacus, on May 4, were observed by Mr. Denning, and, on analysing his observations, he arrives at the conclusion that *real* changes do present themselves in the details of several Martian features, although many of them may be only temporary and due to atmospheric causes.

As regards the question of Martian canals, Mr. Denning states that there is no doubt as to the objective reality of the streaked and striated appearance of the northern hemisphere, and to him the canals appear not as straight and narrow lines, but as currents of dark material with frequent condensations having the appearance of a natural rather than an artificial origin.

SEISMOLOGICAL NOTES.

THE fourteenth number of the *Publications* in European languages issued by the Earthquake Investigation Committee of Japan is entirely devoted to a profusely illustrated paper on the modulus of rigidity of rocks, by Mr. S. Kusakabe. The experiments, which are a continuation of investigations made by Prof. H. Nagaoka on the elastic constants of rocks, relate entirely to torsion, and show, amongst other things, that even for very small strains Hooke's law does not hold, that in the relationship of stress to strain, or twisting couple to twist produced, rocks exhibit a marked *hysteresis,* and that the modulus of rigidity of a rock in its virgin state is greater than is usually supposed. Inferences to be drawn from these important investigations (in which stresses are applied *slowly*) are that waves of small amplitude are propagated with a higher speed than those with a large amplitude (increase an amplitude ten times and the velocity is reduced to half or one-third), also in a strained medium, as for example, along a mountain chain, velocity is somewhat increased. In view of the first of these inferences, Mr. Kusakabe does not see the necessity to assume that the tremors of an earthquake follow paths different from that of the large waves or shocks. Whether we agree or disagree with this suggestion, we can congratulate the author on his important memoir, which is a new leaf in seismometrical research.

Amongst other recent publications relating to earthquakes we have before us Nos. 13 and 14 of the new series of *Mitteilungen* issued by the commission appointed by the Vienna Academy of Sciences for seismological investigations.

The first of these, by Dr. R. Hoernes, gives an account of the earthquake which, on July 5, 1902, resulted in considerable destruction along a line to the east of Saloniki, and fairly parallel with the Vardar River. This is a fault line along which there are hot and other springs. From the fact that these became muddy, altered in temperature and in volume, whilst new springs were created, as at Güvezne, the inference is that the earthquake was accompanied by subterranean rearrangements of strata. A discussion of the movements along this and other fault lines in Macedonia, and of changes in level which are apparently in progress at Saloniki and its neighbourhood, leads to the conclusion that hypogenic geological processes have in this part of the world a marked activity.

The second communication, from Prof. Dr. W. Láska, is on the determination of the distance of earthquake origins from observing stations by means of seismograms. That the differences in time between the arrival of various phases of earthquake motion vary with the distance an earthquake has travelled is a fact which has received application for many years. In the reports of the Seismological Investigation Committee of the British Association (1900 and 1902), by means of curves the relationship between the time intervals and distances is expressed geometrically. Dr. Láska gives similar information by means of tables. From observations made at three stations he also gives equations the solution of which leads to the determination of a latitude and longitude for an epicentrum. In the British Association report for 1900 simpler and more certain solutions are given for the same problem.

In No. 15 of the same *Publications* Dr. Eduard Mazelle gives the results of his investigations respecting the connection between microseismical pendulum movements, the wind, barometric pressure, the state of the ocean, and other natural phenomena. The results at which the author arrives confirm the results from similar analyses made many years ago in Japan, and to be found in the *Transactions* of the Seismological Society of that country and in the reports of the British Association. We are told that it is difficult to find a direct connection between tremors and atmospheric

pressure. Tremors occur most frequently, but by no means always, with marked changes in pressure. An observation more novel in its character is that days when pendulums were much disturbed in Trieste coincided with corresponding disturbances in Strassburg. It is apparently taken for granted that the tremors recorded have a seismic origin.

In No. 16 Dr. J. Knett publishes a list of 507 shocks which were recorded between February 13 and May 6 in north-west Bohemia, which he follows in No. 18 by an account of an earthquake which on November 26, 1902, disturbed the same country.

No. 17, by Adolf Faidiga, is a lengthy description of the earthquake which, on July 2, 1898, created considerable destruction on the coast of Dalmatia, the vibrations from which reached Great Britain. It is largely of local interest.

In Nos. 2 and 3 of vol. ix. of the *Bolletino Della Societa Sismologica Italiana*, the well-known earthquake register published by this body is brought up to March 5, 1902. This is supplemented by two papers. In No. 2 Dr. A. Ricco adds to the knowledge we possess respecting the crater of Etna, and changes which are taking place in the same. On August 23, 1900, the interior of the crater was described and photographed. Its depth was then 282 m. On July 21, 1903, it was again photographed, and its depth was found to be 490 m. The supplementary contribution to No. 3, by S. Costanzo, is on the relationship or want of relationship between the wind and tromometric movements. The author apparently holds with Bertelli and others that the pendulum movements have an endogenous origin, and are not produced by the wind, but that they accompany, precede, or follow falls in barometric pressure. Dr. Agamennone regards the movements in question as being in great measure influenced by the wind. Our own experience, which is detailed in the *Transactions* of the Seismological Society of Japan, reports to the British Association, and in other works, is that vertical or horizontal pendulums, chemical balances, and like apparatus are set in movement when there is a marked fall in barometric pressure, a steep barometric gradient, or a marked fall in temperature; the movements more frequently occur during the night and in winter than during the day and in summer, and they may or may not occur with heavy gales. Instruments in a close atmosphere, as, for example, in a cellar, are more likely to be disturbed than similar installations in a well ventilated or even draughty room. Burning a lamp or a gas jet in a room frequently brings so-called microseismic storms to an end, and what occurs and creates annoyance in one room may not be observed in a neighbouring apartment.

In vol. ii. of the reports of the Mathematical-Physical Society of Tokio, amongst forty-seven papers which for the most part are mathematical we find five by Dr. F. Ōmori and one by Mr. A. Imamura which relate to seismology. The former of these contributions may, to a large extent, be regarded as epitomised reproductions of papers previously published by the Tokio Earthquake Investigation Committee, which we have already noticed (NATURE, April 30, July 9, 1903). In a note on the seismograms of distant earthquakes, Dr. Omori tells us that the "motion consists of a series of different epochs, in each of which the period remains essentially constant, while the amplitude, on the whole, is also constant, except for the occurrence of maximum and minimum groups." In a table we find ten groups, in which the periods vary between 1·02 and 66 second. After discussing the amplitudes and durations of these various phases, it is shown that the arcual velocities vary between 2 and 11·3 km. per second; as the result of more accurate work, this last quantity is now raised to 14·1 km. per second. One argument in favour of the supposition that the preliminary tremors and other phases of earthquake motion follow arcual paths is that the durations of these successive phases are proportional to the arcual distances they have travelled, and these durations are approximately equal to each other. The speeds for certain earthquakes were determined by dividing the difference of the distances of Tokio and certain European stations from an origin by the difference of the times of the arrival of seismic waves in Tokio and Europe. This, it must be observed, involves the idea that the velocity of preliminary tremors on short paths or on long paths is equal. Lastly, it is assumed that each phase recorded at a distant station originated simultaneously at the earthquake origin.

The results to which we are led by assumptions of this nature are well illustrated in the paper, "Notes on Milne Horizontal Pendulum Seismograms," by Mr. A. Imamura. In this paper records of the Guatemala earthquake of April 19, 1902, as published in circular No. 6 by the Seismological Investigation Committee of the British Association, are analysed. One result is to show that the preliminary tremors had an arcual velocity of 15·6, whilst the eighth phase of motion had only a velocity of 2·1 km. per second. These determinations, amongst other things, depend upon the time at which this earthquake originated, which Mr. Rockstroh, in Guatemala, gives as 2·27 a.m. G.M.T. This, it must be observed, apparently depends upon a single observation made at some distance from the epicentre. As being more probably correct, Mr. Imamura adopts 2.26 a.m. as the time of origin. Curiously enough, the determination of the exact time at which this particular disturbance took place became a matter to be considered by the law. At or about the time of the earthquake a certain block of buildings insured against fire, but not, as was stipulated in the policy, against fire occasioned by an earthquake, was burned down. The owners of the block claimed that the destruction was occasioned by the overturning of a lamp immediately before the earthquake, and if this were the case, the loss naturally fell upon the insurance company. The result was that a careful inquiry was instituted to determine the time when Quezaltenango and other cities were wrecked, and, so far as the writer knows, the time given for this occurrence was 2h. 21m. or 2h. 22m., which is a time that falls in line with what we know of earthquake speeds, and the times at which this earthquake was recorded at stations cooperating with the British Association in North America and round the Atlantic. If this latter time is fairly correct, and we therefore add 4 or 5 minutes to the time ordinates given by Mr. Imamura, we see that the times for transit of the first phase of earthquake motion are *not* proportional to arcual distances. The speed over short paths is less than it is over long paths. When we look at phase 8, which occurs about twenty minutes after the maximum, and see the many phases which follow, we do not see the reason why the transit velocity of phase 9, or even of phase 20, should not have been considered.

Following the maximum, as an earthquake dies there is almost invariably a series of fairly rhythmical impulses which gradually grow less in amplitude. These are separated by intervals of from two to five minutes, and may extend over two or three hours. Inasmuch as these phenomena may be observed equally well near to an earthquake origin as at a distance from the same, it would be unreasonable to suppose that if we were at a short distance from a centrum the movements last recorded there had been two or three hours longer on their journey than those first recorded. In rocky materials waves of small amplitude may travel more quickly than those of larger amplitudes; in an earthquake there may be ripples due to surface tension together with the more pronounced compressional, distortional, and gravitational waves, all of which may originate at practically the same time, but if we consider this to be the case for the followers of the main portion of a seismic disturbance, we are led to conclusions apparently unacceptable. The fairly uniform time spacing between the expiring efforts of an earthquake as recorded at a distance from an origin or near to the same, rather than leading to the conclusion that paths are arcual, suggests a rhythmical series of surgings possibly due to interferences or reflections at or near a centrum. A collapse takes place and a mass is launched upon some substratum. Each has its natural period, and when these coincide, it seems possible that at approximately equally spaced intervals a more vigorous set of waves starts out and adds to the train of its predecessors.

The first response to the primary disturbance may be the well-known *Uri Kaishi*, or return shaking, whilst its followers, which die down rapidly in amplitude, like the swinging of a damped pendulum, resemble a family series, children with children's children decreasing in vigour, not born simultaneously, but successively.

The general criticisms on the behaviour of the Milne horizontal pendulum are made without any reference to the

object for which it was installed, which was to determine "the times at which various phases of motion are recorded" (see British Association Reports, 1897, p. 130. Copy of a circular sent to foreign Governments and colonies). This it does, and a little more. If an observer desires to have an open diagram, he must employ clockwork to drive the record receiving surface at a higher speed, whilst a longer period than the one usually employed can be obtained by adjustment. It must, however, be remembered that the period obtained at one station may, on account of the wandering of the pendulum and "tremors," be unpractical at another, and that difference in adjustment at different stations destroys uniformity. Although with the object of stimulating further research we have criticised certain portions of the work before us, the bulk of it commands the admiration and thanks of all seismologists.

THE GILBERT TERCENTENARY.

THE tenth of this month was the three hundredth anniversary of the death of Dr. William Gilbert, the celebrated Elizabethan philosopher who laid the foundations of the science of electricity. The occasion was celebrated on Thursday, December 10, at the meeting of the Institution of Electrical Engineers by the presentation of a picture by the Institution to the town of Colchester, in which place Gilbert was born and died. The picture was painted by Mr. Ackland Hood; it is a fine historical painting representing Dr. Gilbert showing his electrical experiments to Queen Elizabeth.

The proceedings were opened by the president of the Institution with a short speech. Prof. S. P. Thompson then gave a brief address, in which he outlined Gilbert's life and his contributions to science. Gilbert was born in Colchester in 1544, and was educated at the school there and subsequently at St. John's College, Cambridge, at which he became mathematical examiner and senior bursar. He took the degree of M.D. in 1569, and rapidly advanced in the profession, becoming in 1599 president of the Royal College of Physicians, and a year later physician to the Queen. He died at Colchester on December 10, 1603, and was buried there in the Church of Holy Trinity. Eminent as he was as a physician, his claim to immortality rests not on his work in medicine, but on his pioneering investigation in the then almost non-existing sciences of magnetism and electricity. To him we owe the science of terrestrial magnetism; by numerous and careful experiments upon the loadstone he discovered many of the most important principles of magnetism, such as the existence of a magnetic field—an "orbe of virtue"—around the magnet, the screening effect of iron, and the destroying effect of heat. From experiments on a globular loadstone he was able to evolve the theory that the earth is itself a great magnet. Thus many years before Bacon, who is usually regarded as the father of the inductive method, Gilbert was using this method with signal success.

Gilbert's contributions to electricity are contained in the second chapter of Book ii. of the celebrated "De Magnete." He showed that not amber alone, but many other bodies, which he put in a class called *electrics*, can attract solid bodies when rubbed; that they attract everything, not merely straws or chaff; that damp weather hinders the electrification; and that a flame destroys it, as well as many other important facts which are now the fundamental principles of the science. He invented the electroscope, and discovered that the force of attraction is in a straight line towards the electrified body. From these simple beginnings has been gradually evolved in 300 years the immense structure of pure and applied electricity.

The Mayor of Colchester thanked the Institution for its gift in a brief and humorous speech. Amongst many other distinguished men present at the meeting were Sir W. Huggins, president of the Royal Society; Sir Dyce Duckworth, treasurer of the Royal College of Physicians, an office twice held by Dr. Gilbert; Prof. J. Larmor, representing St. John's College, Cambridge; the Mayor of Westminster; and Mr. Ackland Hood, the painter of the picture.

AGRICULTURAL NOTES.

THE third report on the Woburn Experimental Fruit Farm, recently issued by the Duke of Bedford and Mr. Spencer Pickering, F.R.S., is devoted to a discussion of the effects of grass on apple trees. In previous reports it was shown that grasses prove most injurious to young apple trees, and the experiments described here were designed to throw light on the causes of injury. Up to the present time the cause, or causes, have not been discovered, but the experimenters have made considerable progress, for they have shown that their first suspicions were unfounded. Grasses might reasonably be expected to injure young fruit trees by interfering with their air, or water, or food supply, but the careful experiments recorded in the report indicate that interference with air, water, and food has little or nothing to do with the question, and that the injury "must, in all probability, be attributed to the action of some product, direct or indirect, of grass growth which exercises an actively poisonous effect on the roots of the tree." This conclusion is based partly on the negative evidence of the experiments, in which the supplies of food, air, and water were controlled, and partly on the appearance of the trees grown in grass. These trees were always very sharply marked off from the others by peculiar tints of leaf and fruit, quite unlike those due to starvation, and produced obviously by some unhealthy condition of soil. The effects of grass on apple trees have been studied only on the shallow clay soil of the Woburn Fruit Farm and on a clay soil at Harpenden, and it is possible, as the experimenters are careful to point out, that on a richer soil, and in a different climate, grass might not prove injurious, but the Woburn experiments clearly indicate that horticulturists should avoid planting apples in grass, unless there is local evidence that grass does not injure the young trees.

In their work on apple trees the Duke of Bedford and Mr. Pickering are dealing with a special and well-marked case of a general problem of great interest to agriculturists—the effects of crops and of crop residues on the quality of soil. Every observant cultivator knows that land may get "sick" or "over-cropped" when a plant is grown too often, and he also finds that certain plants "exhaust" the soil in a peculiar degree for certain other plants. He has been told that this is a "food" or a "special food" question, and that interference with the air, food, and water supply explains all the ills which plants may suffer from competition with their fellows. At the same time, he does not feel satisfied that such phenomena as the disappearance of clover from land, or the effects of rye-grass on wheat are due to straightforward competition, and the "poison" theory of the Woburn experimenters will arrest his attention. Seventy years ago agriculturists were discussing De Candolle's "excretory theory," and found in it the chief explanation of the benefits due to a rotation of crops; when the theory was abandoned the facts from which it originated were forgotten, and in connection with the effects of grass roots on apple trees the following sentence from De Candolle is worth recalling:—"Thus we know that the thistle is injurious to oats, the Euphorbia and Scabiosa to flax, the *Inula betulina* to the carrot, the *Erigeron acre* and tares to wheat, &c." Though the plant does not "excrete," it may readily influence the character and condition of the soil either directly by the decomposition of its roots, or indirectly through its effect on soil organisms, and the Woburn experiments, which deal with this subject, will be closely followed.

In a paper entitled "Recherches sur la Synthèse des Substances Albuminoides par les Végétaux," MM. Laurent and Marchal, of the State Agricultural Institute, Gembloux, give a useful *résumé* of the sources of nitrogen to plants. In doing so they point out that during the latter half of the nineteenth century there was a tendency to overlook the importance of ammoniacal compounds, and to regard nitrates as the only sources of nitrogen to the higher plants. While nitrates are of chief importance, there are many plants, even colonies of plants, such as forest trees and the vegetation of marshes, that must depend largely or entirely on compounds of ammonia for the supply of nitrogen. The authors describe experiments on cress, white mustard, chicory, asparagus, white melilot, Persian lilac, and tobacco, and among other conclusions state that sun-

light is necessary for the synthesis of albuminoids in the higher green plants, and probably in all green plants, but that amides are produced in limited quantities in darkness and in parts of the plants which contain no chlorophyll. The lower plants devoid of chlorophyll can manufacture albuminoids in darkness, the necessary energy in this case being derived from the decomposition of organic compounds.

The twenty-third volume of the *Agricultural Journal* of the Cape of Good Hope is now being published in monthly parts by the Department of Agriculture, Cape Town. Though not new, the *Journal* has recently altered and improved its form, and this sixpenny monthly may be commended to the notice of all who are interested in the agriculture of South Africa. Prospective settlers would find many useful hints in it, for by means of editorial notes, special articles, and correspondence the *Journal* gives a clear presentation of the condition of the various farming industries of Cape Colony. Diseases of live stock are very common in the colony, and young men preparing for life on a South African farm should endeavour to gain some knowledge of veterinary hygiene before going abroad. The *Journal* usually devotes one or two articles in each number to veterinary subjects and the ailments of stock bulk largely in the correspondence columns. A correspondent from Aliwal North, writing in the October number, makes an observation which is interesting in view of the importance of ticks as carriers of disease germs. He reports that he had a flock of goats badly infected, but "happened to drop" on a cure in the shape of wild garlic. He gave the affected animals a small quantity; the ticks were not killed, but they dropped off the goats, and no further loss was suffered. Next year, when the tick season came round, the goats escaped injury.

Regulations for the purpose of preventing the importation of plant pests have been in force in Cape Colony for a number of years, but experience has shown greater caution to be necessary, and after January 1, 1904, new and stringent regulations will come into force. With the view of preventing inconvenience and loss to exporters, wide publication has been given to the altered regulations. The following points are of special interest to horticulturists:—(1) All plants or parts of plants not grown in South Africa must in future be sent to Cape Colony by sea. Imported plants must not be sent overland from other colonies. (2) Certain plants are absolutely prohibited, as, for example, stone-fruits from the U.S.A. and Canada, and peaches from any foreign country. (3) Permits are granted for the importation of small quantities of fruit trees from most countries, so that stocks of new varieties may be worked up in the colony. (4) Plants will be examined on landing by a competent officer, thus minimising the risk of importing pests. Trees and woody plants will be fumigated, the expense of fumigation being borne by the consignee. Any plants or parts of plants on which the examining officer finds a specially dangerous pest will be destroyed without delay.

BUDDHISM.[1]

THE appearance of the first number of a new quarterly magazine entitled *Buddhism* is an event of some significance, for it argues that the modern tendency of western inquiry into the ethics of this ancient eastern faith is sufficiently active to justify a commercial venture.

The object of the review is stated to be, first, to set before the world the true principles of the Buddhist religion; secondly, to promote certain humanitarian activities enjoined by Buddhist precept; and, thirdly, to unite, "as by a common bond of mutual interest and brotherhood, the many associations with Buddhist aims which now exist."

These objects are well sustained in the initial number of the review. It opens, most appropriately, with a poem by Sir Edwin Arnold, whose "Light of Asia" has probably done more to popularise Buddhism in the west than any literary effort hitherto known. It continues with a series of essays by Buddhist writers, in which the doctrines of Buddhism are explained and advocated with much earnestness, and, on the whole, with an intelligent appreciation of the limitations of ordinary human understanding; and it includes notes and references which sufficiently prove what an active agency in the practical world Buddhism is becoming. Amongst the notes is an invitation to western students to join the great brotherhood of the Yellow Robe, with a very explicit statement of the conditions under which candidates will be accepted. "Bhikkus of occidental nationalities" are first invited, "who in due time would be able to return to their own countries, there to spread the knowledge of Buddhism"—in short, missionaries. Amongst these Bhikkus there may be some who may be willing to take the Robe, but they are candidly warned that the conditions of life in the order are "somewhat severe for occidentals."

All this is practical business, and it leaves an impression that the review fills a space in the ranks of modern Oriental literature which is distinctly open to enterprise.

The article on the "Faith of the Future," coupled with that on "Nibbana" (Nirvana), is a clear and intelligible exposition of the gospel of law and self-culture inculcated by Buddhism, and is, perhaps, a clearer analysis of the final conditions of nebulous existence which crowns and completes the strenuous life of the Buddhist than can be found in most theological treatises on the Christian's hereafter. Based on the unsafe assumption that the "destructive fire of science" has annihilated revealed religion, it offers the alternative of the old world ethical system which is not founded on revelation at all—"the system of ontology founded on reason rather than belief"—which advocates the culture of the highest faculties of the mind; and teaches man that, avoiding all vain speculations about God and the soul, or his future self-conscious identity, he should concentrate his attention on existence as he finds it, and learn that all evil springs, not from the life without, but from the heart within, its cravings and its desires. "The attainment of true and lasting happiness is for him alone who from his own being shall eradicate the Cause of Sorrow, shall free his heart from all this grasping at straws in life's fierce waters, and from all this thirst after its false salt waves. And the way in which this may be done . . . is Truth the Fourth," &c.

The writer of the essay would do well to avoid overstating his case. It is not the fact that Buddhism has done more towards civilising the world than any other religion, nor can the proposition be unconditionally accepted that it has added more towards increasing the great sum of human happiness and peace than any other; for it is an indisputable fact that in this imperfect world (so slowly developing towards more perfect ends through the agency, not of one, but of all reasonable religions) war has, after all, been the great civilising agent, the cleansing and purifying principle which has age after age reconstructed higher forms of civilised existence on the ashes of destroyed communities. And war is wholly and absolutely obnoxious to Buddhist principles. As for the peaceful and happy conditions of such nations of the world as still recognise the gentle rule of the Buddhist priest, we may still be open to serious doubt. The Burmese, truly, are a light-hearted race—but is this due to self-culture, or environment? In Ceylon, alas! virulent family dissensions ending in crime are (or were but a few years ago) peculiarly frequent.

It is, however, impossible to do more than note the general character of the review. It is well written (there are two delightfully descriptive articles on "The Woman of Burma" and the "Shadow of the Shwe Dagon"), well printed, and well illustrated, and will do much to familiarise the European reader with the active principles of an eastern faith which is older than Christianity, and is professed by 500 millions of his human contemporaries. In the modern world of free thought and toleration such a magazine as this should be welcome, and it would not be surprising if it attained a wide circulation.

[1] *Buddhism*, an Illustrated Quarterly Review. (Printed and published for the International Buddhist Society by the Hantnawaddy Printing Works, Rangoon, Burma.)

TECHNICAL EDUCATION IN GERMANY.

THE excellence of the German system of higher scientific and technical education has been referred to in many articles which have already appeared in NATURE, and the lavish endowment by the State in Germany of the institutions in which the education is given was dealt with in our issue for March 12 (vol. lxvii. p. 433). We are glad to find that public attention is being again directed to the same subject by the *Times*, and that an exhaustive comparison

between the supply of technical education in this country and in Germany was made in a valuable article which appeared in the issue of that journal of November 9.

Most of the English technical schools have, says the writer in the *Times*, for their principal object the teaching of actual industries. In Germany, on the other hand, the term has come to be associated more and more with pure knowledge, and is now commonly reserved for those advanced academies which teach the science underlying industries, but not the industries themselves. What we generally call technical schools are in Germany called "Fachschulen," or Gewerbeschulen, that is, "trade schools," which fall into two main groups. The first group provides instruction for apprentices in the hand trades and for artisans, and may be called "lower trade schools." The second group is large and of great direct importance to the manufacturing industries. The "technical schools" in our large manufacturing towns correspond most nearly to these institutions, which may be called "higher trade schools." Then above these is the highest class, namely, the "technical high schools," which do not correspond to any of our educational institutions. This classification gives a clear view of the special educational provision for industrial life in three broad divisions:—(1) ordinary workmen; (2) those above the grade of workmen from foremen to manufacturers; (3) the high scientific experts, consultants, and innovators.

The main differences between the higher trade schools and the corresponding English technical schools are two—they are more specialised, and are chiefly intended for and used by superior students. There is some provision for workmen, but, as a rule, comparatively little advantage is taken of it. The classes proper are held in the day, and cannot be attended by men at work; those thronged evening lecture-rooms and laboratories filled with young fellows out of the factories and workshops which may be seen in any large manufacturing town in England are almost unknown in Germany. The real meaning of this is that the English schools cater for students in a lower rank of life and teach a much larger number of subjects. The German schools of this class, on the contrary, are quite clearly differentiated. They are not quite so restricted as the description applied to them suggests. The "weaving" schools, for instance, generally embrace all the main textile processes. But they are strictly devoted to some special branch of industry, and their main function is to enable students, who are to occupy superior positions, to acquire a thorough mastery of the skilled processes. Our own textile schools do excellent work, and, so far as affording opportunities to the working classes is concerned, they do far more than the German ones, but they do not command the same superior material. The reason for this is that there is not yet the same inducement to young men who have had a superior liberal education to take up the career of manufacturers' expert. This fact is really at the bottom of the question of scientific education. Given the demand, the supply will follow. The lesson to be learnt from Germany is to make industrial science a sufficiently attractive career for those who have received a superior general education, and particularly a full classical one. The Germans have no belief in the American plan of teaching trades wholly in schools. With regard to finances, these schools are supported by fees, endowments, municipal and State grants, but the general tendency is towards more and more State support and State control.

The technical high schools, of which there are nine, with two more in preparation, represent a further step. As the superior grade of trade schools has been developed from a lower, so the high schools have been developed from trade schools to meet still higher requirements. They have the *status* of universities, are self-governing, and do for the industrial professions what the universities do for the learned professions—that is, impart the highest training in those principles which form the theoretical groundwork of practice. The technical high schools do not supersede or overlap the universities: they supplement them.

The technical high schools have no uniform curriculum, but all of them teach architecture, civil and mechanical engineering, chemistry, mathematics, and physical science. Exceptional subjects are naval architecture (Berlin), mining (Aachen), forestry (Stuttgart), agriculture (Munich). Pharmacy is taught at Brunswick, Karlsruhe, and Stuttgart, and at the last there is a railway, post, and telegraph course. Previous practical knowledge is generally required, as in the trade schools, and more rigidly insisted on. The high school is even less than the trade school a substitute for apprenticeship.

The two really important departments of the technical high schools are chemistry and electrical engineering. It is impossible to exaggerate the importance of the first; it enters into every branch of manufacture, and becomes more potent every day. At the high school teaching and experiment are pushed to the furthest theoretical limits, and the value to Germany is incalculable. Her chemical industries are reckoned to bring in fifty millions a year, but the application of chemical knowledge goes far beyond that and extends into a thousand channels. Nor can any man tell what it may bring forth to-morrow. This is the great lesson in industrial science that the high school has to teach. But it must not be forgotten that chemistry can be, and is, equally well taught at the universities. So, too, electrical engineering, which has also been of immense value to Germany; but her rapid industrial advance in that line, compared with ourselves, is due less to superior knowledge than to the gratuitous retardation of the home industry by Government regulations.

SOCIETIES AND ACADEMIES.

London.

Physical Society, December 11.—Mr. James Swinburne, vice-president, in the chair.—A method of mechanically reinforcing sounds, by the Rev. T. C. **Porter**. If a tuning-fork be sounded and placed in a flame, there is a very marked reinforcement of the sound. This is proved not to be due to resonance in the ordinary sense, but to the change from continuous to intermittent combustion. In certain circumstances the impulses given to the air external to the flame, by the waves of burning gas, are more forcible than those given by the unaided sounding body. Thus a new way of reinforcing the sounds given by a vibrating body is found, and the rest of the paper demonstrates this for the phonograph, a *flame* being used instead of the ordinary *trumpet*. Coal-gas and air are brought by tubes into the chamber of the "reproducer" and thence to a jet, where they are burnt. The vibrations of the reproducer are thus impressed on the issuing gas and air, which burn synchronously with them, the sounds thus emitted being easily heard over a large room. In practice it is found best to spread out the flame by a second jet of air, or of mixed air and gas, placed close to the first jet and at right angles to it. The author describes the nature and quality of the sounds emitted by the flame, and the modifications of these which may be produced.—The Simmance-Abady "flicker" photometer, by Messrs. **Simmance** and **Abady**. The principle of the flicker photometer, discovered by Prof. O. N. Rood ten years ago, has frequently been remarked on, but attempts to design a trustworthy apparatus depending upon this principle have hitherto been unsuccessful. The authors, guided by the following rules, have designed a photometer which is capable of balancing and comparing the most violently contrasted tints:—The light-effects must be in juxtaposition without any apparent division line, and must move, oscillate, or rotate so that the point of juncture of the rays of the two lights passes and returns entirely across the vision field. Any hiatus, or longer exhibition of one light than the other, biases the result. The observation surfaces, or surfaces upon which the light rays fall, must be at exactly the same distance from the eye, at exactly the same angle in relation to the line of sight, and must be of pure white, such as is afforded, for example, by a clean chalk, plaster of Paris, magnesium carbonate, or barium sulphate; any tint affects the accuracy of the result. The observation surfaces must also themselves in turn occupy the field of vision; an apparent movement or optical illusion does not afford accurate results.—Mr. Rollo **Appleyard** exhibited a "conductometer" the theory and mechanical details of which are fully described in the *Proceedings* of the Institution of Civil Engineers, vol. cliv., session 1902–3, part iv.—Prof. L. R. **Wilberforce** exhibited

a model to illustrate various properties of wave-motion. The model consists of a series of brass balls suspended in a line by spiral springs and capable of transverse or up and down motion. The balls can be set in vibration by releasing them from extreme positions by means of triggers, one set of triggers controlling the up and down motion, and another set the pendular.

Chemical Society, December 3.—Prof. W. A. Tilden, F.R.S., president, in the chair.—The molecular formulæ of some fused salts as determined by their molecular surface energy, by Mr. J. F. **Bottomley**. Measurements of the variation of capillary rise of fused sodium and potassium nitrates with temperature have shown that these salts probably exist in a fused state in the form of complex molecules containing nine or ten of the molecules represented by the simple formulæ $NaNO_3$ and KNO_3.—The atmospheric corrosion of zinc, by Mr. G. T. **Moody**. It is shown that the semi-crystalline scale formed on the surface of the metal when zinc is exposed to the atmosphere consists of a hydrated carbonate. The same compound is formed when zinc is dissolved in a solution of carbon dioxide and the resulting solution is exposed to the air. From these experiments the author concludes that carbon dioxide is the principal agent in the atmospheric corrosion of zinc, as he has already shown it to be in the case of iron.—The formation of urea by the direct hydrolysis of lead cyanate, by Mr. A. C. **Cumming**. When lead cyanate is boiled with water it is decomposed with the formation of urea and lead carbonate.—Acid salts of monobasic acids, by Mr. R. C. **Farmer**. An account of the physical properties of some acid salts of benzoic acid and their derivatives is given.—The solubility curves of the hydrates of nickel sulphate, by Messrs. B. D. **Steele** and F. M. G. **Johnson**. Solubility curves are given for the heptahydrate, α- and β-hexahydrates, and for the dihydrate.—Action of malt diastase on potato starch paste, by Messrs. B. F. **Davis** and A. R. **Ling**. When malt diastase is heated in aqueous solution at temperatures in the neighbourhood of 60° C. its action upon starch paste is weakened, and *dextro*glucose appears among the products of hydrolysis.—The formation of phloroglucinol by the interaction of ethyl malonate with its sodium derivative, by Mr. C. W. **Moore**. It is shown that the condensation product formed in this reaction is ethyl phloroglucinoldicarboxylate, and not the tricarboxylate as stated by von Baeyer.

Mathematical Society, December 10.—Prof. H. Lamb, president, in the chair.—The following papers were communicated:—Mr. R. J. **Dallas**, Proof of a formula in elliptic functions.—Dr. E. W. **Hobson**, On modes of convergence of an infinite series of functions of a real variable. The condition of uniformity of convergence is known to be sufficient to secure the continuity of the function expressed by the sum of an infinite series the terms of which are continuous functions, but the function may be continuous without the convergence being uniform. The necessary and sufficient conditions have recently been made out, and new proofs of them are given in the paper. Another matter discussed is the nature of the conditions which are necessary and sufficient to secure that, when the terms of the series are integrable without being continuous, the function expressed by the sum of the series is integrable. The methods of proof depend upon applications of the Heine-Borel theorem in the theory of aggregates.—Mr. W. H. **Young**, On the distribution of the points of uniform convergence of a series of functions. It is proved that the points in question form an "inner limiting set," and that, conversely, given any such set of points, a series of functions can be constructed having these points, and these points only, as points of uniform convergence.—Rev. F. H. **Jackson**, A generalisation of Neumann's expansion of an arbitrary function in a series of Bessel's functions.—Prof. A. C. **Dixon**, On many-valued Newtonian potentials. The paper deals with a theory on the lines of Riemann's theory of the Abelian functions, but relating to space of three dimensions. The various values of the potential function become different one-valued functions in a bounded simply-connected region, and these various values must be supposed to exist in different co-extensive examples of this region. The chief question is that of the existence of a potential one-valued throughout all the coextensive examples of the region, and having a simple pole at an assigned point in a particular example. Two values of a many-valued potential, which are permuted by description of an irreducible circuit, may differ by a constant or by a variable function.—Mr. P. E. B. **Jourdain**, On functions all of whose singularities are non-essential.—Prof. J. D. **Everett**, On normal and anti-normal piling. The object of the paper is to exemplify a convenient method of dealing with systematic assemblages of points. Normal piling denotes a particular homogeneous assemblage, whereas the arrangement in anti-normal piling is made up of two homogeneous assemblages. Both arrangements give the maximum of compactness.—Lieut.-Colonel Allan **Cunningham** made a preliminary communication on some properties of Fermat's numbers. If $F_n = 2^{2^n} + 1$ and P is a product of F's, the smallest suffix (a) exceeding unity and the highest not exceeding $2^a - 1$, then $2^{P-1} \equiv 1 \pmod{P}$ and $2^{P(P-1)} \equiv 1 \pmod{P^2}$.

Entomological Society, November 18.—Prof. E. B. Poulton, F.R.S., president, in the chair.—Mr. G. C. **Champion** exhibited numerous specimens of both sexes of *Xyleborus dispar*, from Moncayo, Spain, taken out of beech-stumps.—Mr. F. B. **Jennings** exhibited (1) on behalf of Mr. H. Britten, of Great Salkeld, Cumberland, a specimen of *Tropiphorus tomentosus*, Marsh., from Great Salkeld, showing the deciduous false mandibles intact; (2) a ♀ specimen of *Anchomenus parumpunctatus*, F., from the same locality, showing a malformation of the middle right tibia which was abnormally thin, and bent in the centre, but thickened at the base; the right antenna also had the last seven joints flattened and dilated. Mr. Jennings also exhibited, on his own behalf, *Apion sanguineum*, De G., taken at Brandon, Suffolk, in August last, on Rumex.—Mr. H. St. J. K. **Donisthorpe** exhibited *Apium sorbi*, ♂, taken this year at Freshwater, Isle of Wight, and said that the ♂ of this species was extremely rare.—Mr. M. **Burr** exhibited two ♀s and two ♂s of the largest known earwig, *Anisolobis colossea*, Dohrn., from New South Wales, representing the extremes of size, the average size being between these two extremes.—Mr. A. J. **Chitty** exhibited a specimen of the beetle *Homalium testaceum*, taken in Blean Wood in 1900, and a pair of bees, *Nomada guttulata*, of which the ♂ has never been recorded hitherto in Britain, taken by him at Huntingford, Kent, in May last.—Dr. Norman **Joy** exhibited (1) *Euconnus mäklini*, Mannerh., taken at Bradfield in July, 1901, new to the British list of Coleoptera; and (2) a series of beetles taken at Bradfield at the exuding sap of trees attacked by *Cossus ligniperda*.—Colonel J. W. **Yerbury** exhibited specimens of rare British Diptera, including *Leptopa filiformis*, Lett., *Thyreophora furcata*, *Pelidnoptera nigripennis*, and *Lucina fasciata*.—Dr. T. A. **Chapman** exhibited specimens of *Chrysophanus phlaeas* captured at Reigate, Locarno, and in Spain, showing the apparent effects of temperature on the coloration and wing markings.—Mr. G. J. **Arrow** showed specimens and diagrams illustrating a remarkable kind of variability noticed in beetles of the Trogid genus Acanthocerus. These beetles have the faculty of rolling themselves into a ball, in the interior of which all the vulnerable parts are enclosed. The head forms a large triangular plate in which the eyes appear half on the upper and half on the lower surface. In some examples of the species exhibited (*Acanthocerus relucens*, Bates) the upper division of the eyes forms a large, nearly circular mass, while in others it is reduced to a mere thin vestige, and in extreme examples of another species of the genus it was found to vanish altogether.—Prof. **Poulton** showed an exhibit sent by Mr. A. H. Thayer, of Monadnock, N.H., U.S.A. The greyish silhouettes of two butterflies were represented in a tint nearly the same as the background, but sufficiently distinct to be easily recognisable. On one side of one silhouette a row of white spots had been placed in a submarginal position. It was evident that the adjacent border was thereby rendered far less distinct than that of the opposite side of the silhouette, or of both sides of the other silhouette. The spots in position and shape were approximately as in *Papilio asterias*, and Mr. Thayer considered they possessed a similar significance in this butterfly. Prof. Poulton also exhibited specimens of *Drurya antimachus*, together with the butterflies which he suggested as forming a group synaposematic with it. The central species

appeared to be *Acraea egina*, round which clustered a number of other species of the same genus, so much alike as to be probably indistinguishable upon the wing. Examples of these were exhibited, viz. *A. zetis*, *perenna*, *rogersi*, and *pharsalus*. Another beautiful papilionian member of the group, *P. ridleyanus*, was also shown. The pattern was nearest to that of the male *A. egina*. In fact, so close was the resemblance that Godart had been entirely misled by it, and had described the Papilio under the name of *zidora* as the female of *Acraea egina*.—Mr. Edward **Saunders**, F.R.S., communicated a supplementary note to a paper entitled "Hymenoptera Aculeata Collected by the Rev. A. E. Eaton, in Madeira and Tenerife, in the Spring of 1902."

Geological Society, November 18.—Sir Archibald Geikie, F.R.S., vice-president, in the chair.—Notes on some Upper Jurassic Ammonites, with special reference to specimens in the University Museum, Oxford, by Miss Maud **Healey**. In rearranging the Upper Jurassic fossils in this museum the prevailing misconception with regard to Sowerby's species *Ammonites plicatilis* and *Am. biplex* came under notice. The type-specimen of *Perisphinctes plicatilis* (Sow.) is refigured and described. It appears to be an Upper Corallian form, and is usually taken as the zone-fossil of that horizon. Sowerby's two figures of *Perisphinctes biplex* represent different specimens. One, probably from a Kimmeridge Clay nodule found in the Suffolk Drift, is refigured and described. It would be wisest, the paper suggests, to abandon the name, or at least to restrict it to the abnormal specimen to which it was attached. The original specimen of *Perisphinctes variocostatus* (Buckland) came from the so-called Oxford Clay at Hawnes, but evidence that it was really derived from the Ampthill Clay was given. Sowerby's *Ammonites rotundus* is doubtfully identified as a variety of *Olcostephanus Pallasianus* (d'Orb.). It was derived from the Kimmeridge Clay of Chippinghurst, and is the zone-fossil of the Upper Kimmeridge Clay. —On the occurrence of Edestus in the Coal-measures of Britain, by Mr. E. T. **Newton**, F.R.S. This genus was originally described from the United States, and was afterwards recognised in Russia and Australia. The genus was placed with Helicoprion and Campyloprion in the family Edestidæ. The specimen here described was obtained by Mr. J. Pringle from one of the marine bands between the "Twist Coal" and the "Gin-Mine Coal," in the Smallthorn sinking at Nettlebank (north Staffordshire). The specimen is a single segment of a fossil closely resembling *Edestus minor*, and consists of an elongated basal portion, bearing at one extremity a smoothed, enamelled, and serrated crown. The fossil is not to be referred to any existing species, and a new name is given to it. While it seems most in accordance with present knowledge to regard the "spiral saw" of Helicoprion as the symphysial dentition of an Elasmobranch, possibly allied to the Cestracionts, it does not seem so probable that the forms referred to Edestus are of the same nature. The author thinks the latter are more likely to be dorsal defences.

Zoological Society, November 17.—H.G. the Duke of Bedford, K.G., president, in the chair.—Mr. Henry **Scherren** exhibited and made some remarks on the largest horn of *Rhinoceros simus* yet obtained from the Soudan. He directed attention to the fact that the species appeared to be fairly numerous on the northern boundary of the Congo Free State and in the adjacent parts of the Soudan. —Mr. R. I. **Pocock** exhibited a piece of basalt, picked up on the coast of Victoria, Australia, which contained a web of the marine spider *Desis kenyonae*. This served to illustrate the habit of the spiders of the genus Desis of spinning a closely woven sheet of silk over a crevice in the rock as a protection against the rising tide.—Mr. Pocock also gave an exposition, illustrated by drawings, of a new suggestion as to the use of the white rump-patches of Ungulata, with special reference to the races of Burchell's zebra.—Mr. E. E. **Austen** exhibited and made remarks on specimens of *Glossina palpalis*, the species of tsetse-fly which is concerned in the transmission of "sleeping sickness" in the Uganda Protectorate. He also exhibited, for the sake of comparison, specimens of four other species of tsetse-flies, including *Glossina longipennis*, which occurs in Somaliland, and may possibly prove destructive to the transport animals of the Somaliland Field Force.—Mr. Oldfield Thomas, F.R.S., exhibited, on behalf of Mr. W. E. **de Winton**, a drawing of a skin of a female gazelle—probably *Gazella muscatensis* —from Sheik Oman, near Aden, which showed a perfect hair-whorl on the withers. This whorl had been found to be absent in the male.—Mr. C. Tate **Regan** read a paper entitled "A Revision of the Fishes of the Family Loricariidæ," in which nearly 200 species were recognised as valid, 35 being described as new to science.—Dr. Blanford read, on behalf of Mr. V. V. **Ramanan**, a communication entitled "Early Sanskrit References to the Tiger," in which it was pointed out that the tiger was frequently alluded to in Sanskrit literature, and that Colonel Stewart was in error in stating at a previous meeting that there was no Sanskrit name for this animal.—Mr. F. E. **Beddard**, F.R.S., read a paper on the trachea and lungs and other points in the anatomy of the hamadryad snake (*Ophiophagus bungarus*).—Mr. G. A. **Boulenger**, F.R.S., read a report on the fishes collected by Mr. Oscar Neumann and Baron Carlo von Erlanger in Gallaland and southern Ethiopia. Examples of 19 species, 4 of which were new, were contained in the collection, and these were enumerated and described.

Royal Meteorological Society, November 18.—Captain D. Wilson-Barker, president, in the chair.—Dr. H. R. **Mill** and Mr. R. G. K. **Lempfert** gave an elaborate and interesting paper on the great dustfall of February and its origin. From the maps exhibited it appears plain that the dust reported on February 21 or 22 fell over nearly all parts of England and Wales to the south of a line drawn from Anglesey to Ipswich, except in parts of north Cornwall, Somerset, Wilts, and mid-Wales. The dust usually attracted attention either in the form of a dense yellow haze, like a London fog, or as a reddish-yellow powder, lying thickly on trees and roofs. The fall was often accompanied by temperatures considerably above the average, and by remarkably low relative humidities. In order to ascertain whether the composition of the dust threw any light on its origin, about fifty samples were submitted to the Geological Survey and examined by Dr. J. S. Flett. In addition to the coarser particles, all the samples contained a very fine-grained reddish clay, the particles of which were too minute to be determined mineralogically. This clay was certainly derived from some source beyond the British Isles, but it was not distinctive enough to afford much evidence as to its place of origin. Maps have been constructed showing the distribution of the dust and the meteorological conditions prevailing over the period when it appeared. These form the basis of a discussion by Mr. Lempfert as to the place of origin and the direction of travel of the air which was passing over western Europe at the time in question. The trajectories of the air which reached the southern half of England can be traced backwards in a south-westerly direction to the neighbourhood of the Azores, but here it turns to the south, and finally to the south-east, and is carried back to the north-west coast of Africa on the morning of February 19. The authors are therefore of opinion that there is reason to believe that the air which reached the southern half of England on February 22 started from the north-west coast of Africa on February 19, and they consider this affords strong evidence of the African origin of the dust, and of its having travelled to north-west Europe by a path not very different from that indicated by the trajectories.

Linnean Society, December 3.—Prof. J. Bretland Farmer, F.R.S., vice-president, in the chair.—Dr. Eric **Drabble** gave an account of his recent researches on the anatomy of the roots of palms, illustrated by lantern-slides from his drawings. He stated that the roots of more than sixty species have been examined. Essentially similar results have been obtained from each. It appears that the "medulla" in palm-roots is merely that portion of the common ground-parenchyma, arising at the non-stratified apex, which becomes enclosed distally by fusion of the procambial strands, and hence differs in no respect from the external "cortical" parenchyma. An attempt was made to extend this idea to other vascular plants, and the suggestion was put forward that all ideas of "monostely" and "polystely," and of "medulla" and "cortex" as

separate morphological entities, are based on an artificial conception of the structures involved.—In a paper by Dr. Arthur **Willey,** F.R.S., an account was given of twenty-eight species of littoral Polychæte worms from South Africa, of which four are new. The specimens had been carefully prepared, and the author is satisfied with the results. He comes to the general conclusion that the annelid fauna of the Indo-Pacific region may be said to be composed of an assemblage of endemic, Caribbean, and Mediterranean constituents.—Notes on *Myriactis Areschougii* and *Coilodesme californica,* by Miss May **Rathbone.** The species of Myriactis in question is parasitic on *Himanthalia lorea,* forming very small tufts with a cushion of large torulose colourless cells, deeply sunk in the thallus of the host. Material was obtained from Cumbrae in March which shows penetrating rhizoids belonging to some parasitic alga; they start from the base of the cushion and travel far in the tissues of the host, and the conclusions of the author are that these rhizoids act as stolons for propagating the plant, which seems rather to be an endophyte than a parasite.

Anthropological Institute, December 8.—Mr. H. Balfour, president, in the chair.—The Rev. R. A. **Bullen** exhibited a series of polished and other slate implements from Harlyn Bay, Cornwall. The implements were found on the site of a late Celtic cemetery, the graves of which are lined with slate, buried some twelve feet beneath blown sand. Mr. Bullen was of opinion that the implements showed unmistakably the hand of man, but, in the discussion which followed, Mr. C. H. Read expressed his firm conviction that the implements had been worn, not by man, but by the sand which for centuries had been drifting continually over them. Most of the implements, he considered, were simply chippings from the slate linings of the graves, worn by the sand to their present shape.—Dr. William **Wright** read a paper on skulls from round barrows in east Yorkshire, the skulls in question being now in the Mortimer Museum at Driffield. About eighty of them were examined. The interments, from the evidence of the finds, appeared to date from the early Iron or late Stone age. As to the skulls themselves, Dr. Wright showed that almost every variety of cranial shape was found among them, such widely different types as Sergi's *Ellipsoides Pelasgicus Longissimus, Sphenoides Latus,* and *Cuboides Procerus* being present, while the cephalic index ranged from 69 to 92. In fact, so varied were the types that Dr. Wright felt that it was doubtful whether, in a community of the present day, it would be possible to find a more mixed series of skulls A most interesting point was the extraordinary resemblance, in many cases, between the skulls from any one barrow, in fact it was so striking that Dr. Wright felt inclined to attribute it to the barrows having been family burial-grounds. The resemblance was particularly noticeable in nine skulls taken from one barrow. Four of these had the metopic suture unclosed, and it was interesting, and somewhat unexpected, to find that metopism occurred in long rather than in broad skulls. The conclusion drawn from Dr. Wright's paper was that Thurnam's dictum of "round barrow round skull" was not even approximately accurate so far as skulls from the round barrows in Yorkshire were concerned.

Manchester

Literary and Philosophical Society, November 17.—Prof. H. B. Dixon in the chair.—Prof. **Lamb** exhibited and described two photographs, taken at the Isle of Man by Mr. Hiller, one of which showed very clearly the interference between the direct and reflected waves on the sea coast. The points of intersection of the two systems of waves were particularly well marked. Mr. T. **Thorp** exhibited a small glass tube containing a little radium bromide at the sealed end, and terminating in a bulb at the other end. The whole formed a vacuum tube, and was a very convenient and portable instrument for showing the fluorescence of radium bromide on a barium platino-cyanide screen in the dark. He also stated that the bulb caused a charged electroscope to discharge very rapidly.—Messrs. R. S. **Hutton** and J. E. **Petavel** described some experimental work which they have undertaken with the view of studying the effect of high gaseous pressures upon electric furnace reactions. The investigation is being carried out in the electrochemical laboratory of the Manchester University. The preliminary results only were given, progress having been necessarily slow up to the present. The several dispositions of the furnace and of the arcs were described, and photographs of them thrown upon the screen. To obtain satisfactory results it is necessary to exceed the laboratory scale of operations. For the present the work has been confined to the production of calcium carbide, aluminium and nitric acid as effected by pressures up to 150 atmospheres.

Dublin.

Royal Dublin Society, November 17.—Prof. W. F. Barrett, F.R.S., in the chair.—Sir Howard **Grubb,** F.R.S., read the following papers:—(1) The adaptation of the flotation principle to large telescope mountings; a possible solution of the difficulties encountered in mounting great equatorial instruments; (2) the registration of star-transits by photography; (3) a new form of dipleidoscope; (4) a new surveying instrument for the rapid measurement of horizontal and vertical angles; (5) a new form of position-finder for adaptation to ships' compasses.—Dr. G. H. **Pethybridge** exhibited and described an improved form of potometer.—Sir Howard Grubb exhibited some new forms of geodetical instruments as already described in the *Transactions* of the Royal Dublin Society in May, 1902.

Paris.

Academy of Sciences, December 7.—M. Albert Gaudry in the chair.—Some observations relating to the action of hydrocarbon vapours on animal microbes and on insects, and on the antiseptic *rôle* of oxidising-oxidisable agents, by M. **Berthelot.** In an experiment described by the author, the antiseptic properties usually ascribed to naphthalene were found to be non-existent. There would appear to be a relation between the oxidising power of a body and its antiseptic power.—On the electromotive forces resulting from the contact and the reciprocal action of liquids, by M. **Berthelot.**—On a new Protozoa, *Piroplasma Donovani,* the parasite of an Indian fever, by MM. A. **Laveran** and F. **Mesnil.** A description of a parasite isolated from a case of fever arising at Dum-Dum, near Calcutta. There appears to be no essential difference between this parasite and the Piroplasma already known, in particular, the type *P. bigeminum.* This genus of parasites occupies an important place in veterinary pathology, but this is the first time that a human disease has been traced to it.—On the property of emitting the *n*-rays conferred by compression on certain bodies, and on the spontaneous emission of the *n*-rays by tempered steel, tempered glass, and other bodies in a state of constrained molecular equilibrium, by M. R. **Blondlot.** Numerous substances have been found to give off *n*-rays during compression, recognisable by their action on feebly illuminated phosphorescent calcium sulphide. Substances such as tempered steel and glass, permanently under strain, appear to give off these rays indefinitely.—Observations on the Leonids and Bielids made at Athens during 1903, by M. D. **Eginitis.**—On a theorem on measurable ensembles, by M. Emile **Borel.**—Generalisation of a theorem of Laguerre, by M. A. **Auric.**—On the quality of helices used in aërostats, by M. Charles **Renard.**—On the intensity of the light produced by the sun, by M. Charles **Fabry.** The conclusion is drawn from the experiments described that the illuminating power of the sun at the zenith, at its mean distance, is, at the level of the sea, 100,000 candles.—On the direction of permanent magnetisation in certain volcanic rocks, by MM. Bernard **Brunhes** and Pierre **David.**—The effect of time in the comparison of the luminous intensity of coloured lights, by MM. André **Broca** and D. **Sulzer.** If two lights of different colours are compared in a photometer, the equality is affected by the time during which the disc is exposed to the light. The effects are due to differences in the retinal fatigue for the different colours.—On a new mode of calculating the heats of combustion of organic compounds, and on some of its consequences, by M. P. **Lemoult.**—Researches on azo-compounds. A new mode of formation of the indazylic derivatives, by M. P. **Freundler.**—The action of hydro-

cyanic acid upon aldehyde-ammonia and analogous compounds, by M. Marcel **Delépine.** The results of the experiments described show that the ordinary equations for expressing this reaction require some modification.—A new reaction of hydroxylamine, by M. L. J. **Simon.**—A new method for the preparation of aldehydes, by M. L. **Bouveault.** Disubstituted formaldehydes of the type H.CO.NR.R′ react with magnesium alkyl derivatives to form compounds which, on subsequent treatment with water and dilute sulphuric acid, yield aldehydes. The yields are good, and the method would appear to be of general application.—On the migration of the phenyl group, by M. Marc **Tiffeneau.**—On the esters of isopyromucic acid, by M. G. **Chavanne.** The methyl and ethyl esters of pyromucic acid cannot be obtained by the usual methods, but can be readily isolated by the use of ethyl and methyl sulphates.—On the hydrates of ethyl alcohol, by MM. E. **Varenne** and L. **Godefroy.** From the determination of the viscosity of alcohol-water mixtures, the existence of five hydrates of the alcohol is inferred.—The production and distribution of some organic substances in *Citrus madurensis*, by MM. Eug. **Charabot** and G. **Laloue.**—On the chemical characters of wine arising from vines which are attacked by mildew, by M. Emile **Manceau.** Such wines are distinguished from ordinary wines by several chemical differences, the most important being the increased proportion of albumenoid matters.—On the determination of the primitive form of crystals, by M. F. **Wallerant.**—The revision of the free marine Nematods of the region of Cette, by M. Etienne **de Rouville.**—A parasitic sporozoa of the mussel and other Lamellibranchs, by M. Louis **Léger.**—On the filosity of potatoes, by M. G. **Delacroix.** A study of the cause of the tendency to develop buds which lengthen considerably and remain thin.—On the Permian system in the French and Spanish Pyrenees, by M. J. **Caralp.**—Observations relating to the Tectonic in the mountain valley of Jalomita, Roumania, by M. J. **Bergeron.**

New South Wales.

Linnean Society, September 30.—Mr. Henry Deane, vice-president, in the chair.—The botany of Norfolk Island, by Mr. J. H. **Maiden.** No new species is described, but 45 Phanerogams (Dicotyledons 24, Monocotyledons 21) and 17 Cryptogams (ferns 6, lichens 10, fungus 1) are recorded for the first time as indigenous to the island. Of the Algæ gathered from the shores, all (with one exception) are new records for this particular locality. The paper contains a careful list of introduced plants. Section ii. of the paper deals with early general accounts of the vegetation, bibliography, Ferdinand Bauer and Norfolk Island, early Government gardens on the island, and Phillip Island. An almost complete collection of the Norfolk Island flora is now in the National Herbarium, Sydney.—The slime of *Dematium pullulans*, De Bary, by Dr. R. Greig **Smith.** A race of *Dematium pullulans* was found with *Bact. acaciae* in the gum-flux of the peach and almond. From cultures upon solid and in fluid media a slime was obtained, which proved to be a pararabin.—The physical geography of the Blue Mountains and the Sydney district, by Mr. E. C. **Andrews.** Repeated elevation of subaërially carved and successively formed plains or almost plains (peneplains) is the key to the history of the Blue Mountain and Sydney areas in late geological time. These plains, developed near sea-level, were successively raised to heights of 700–3000 feet above the same base. The elevations imposed a dome-shaped surface upon the area, the axis of the dome being drawn out in a meridional direction. The growth of the present rivers shows the revival of stream activities after a late Tertiary uplift, when the cycle of erosion immediately preceding the present one had advanced to the stage of completion.

October 28.—Prof. T. W. Edgeworth David, F.R.S., vice-president, in the chair.—The geology of the Glass House Mountains and district, Queensland, by Harald I. **Jensen.**—On a new species of Callitris from New South Wales, by R. T. **Baker.** This pine attains a height of about 20–30 feet, and a diameter of from 1–2 feet. The branchlets are slender, with a drooping habit, giving it a facies different from the other Australian species; the fruit cones are almost identical with those of *C. Muelleri*, whilst the terete branchlets are similar to those of *C. robusta*, R.Br. It appears to be a very local species, for after a botanical survey of the pines of this State it has so far never been found except on the top of the Gowie Ranges, north of Rylstone. The name *C. gracilis* is proposed for it in reference to the slender branchlets.—The effect of the Bassian Isthmus upon the existing marine fauna: a study in ancient geography, by C. **Hedley.** The union of Tasmania and Australia has been exhaustively dealt with by Mr. A. W. Howitt, and Prof. Spencer has shown how Tasmanian animals entered Victoria by this vanished land-bridge. The present memoir discusses the barrier such an isthmus would oppose to migration of the marine fauna.—The gum and byproducts of *Bacterium sacchari*, by Dr. R. Greig **Smith.** The gum has been identified as a galactan. The byproducts in the fermentation of saccharose are carbon dioxide, ethyl alcohol, succinic, lauric, palmitic, acetic and formic acids.

DIARY OF SOCIETIES.

THURSDAY, December 17.

Linnean Society, at 8.—On the Docoglossa; a Study in Evolution: H. J. Fleure.

Institution of Electrical Engineers, at 8.—The City and South London Railway; Working Results of the Three Wire System applied to Traction: P. V. McMahon.

FRIDAY, December 18.

Institution of Mechanical Engineers, at 8.—An Inquiry into the Working of various Water-Softeners: C. E. Stromeyer and W. B. Baron.

Institution of Civil Engineers, at 8.—The Action of the Sea upon the Foreshore: C. B. Case.—The Causes of the Loss of Beaches: F. W. Cable.

SATURDAY, December 19.

Essex Field Club, at 6.30 (Essex Museum of Natural History, Stratford).—Report on Protection of Birds in Essex: F. Dent.—Some Pictures of Bird Life at Home and Abroad: R. B. Lodge.

MONDAY, December 21.

Institute of Actuaries, at 5.—The Income Tax as affecting Life Offices, with Special Reference to some Recent Decisions: J. E. Faulks.

TUESDAY, December 22.

Institution of Civil Engineers, at 8.—On the Resistance of Plane Surfaces in a Uniform Current of Air: Dr. T. E. Stanton.

CONTENTS.

THURSDAY, DECEMBER 24, 1903.

LUNGE'S SULPHURIC ACID.

A Theoretical and Practical Treatise on the Manufacture of Sulphuric Acid and Alkali, with the Collateral Branches. By George Lunge, Ph.D., Professor of Technical Chemistry in the Federal Polytechnic School, Zurich. Third edition, revised and enlarged. Pp. xxvii + 1214. (London: Gurney and Jackson, 1903.) Price 2*l.* 12*s.* 6*d.*

THE volumes before us, although bearing the above comprehensive title, in reality deal only with the manufacture of oil of vitriol, and together constitute vol. i. of the complete work. It is now upwards of a quarter of a century since this work was first published, and, thanks to the assiduity and painstaking zeal of its author, it still remains the standard treatise on the subject. Ten or a dozen years ago, at the time of the appearance, in fact, of the second edition of this work, it might have been supposed that all that need be known or stated with regard to a manufacture so highly specialised as that of oil of vitriol was already known, and was described in Dr. Lunge's classical work. But it is a striking instance of the essentially progressive character of chemical science that, even in a branch of its application so well established as this, in which, under the stress of competition, some of the acutest intellects which have ever devoted themselves to chemical technology have laboured for years with a view to make it perfect, there should have arisen during the last ten or twelve years what is practically a revolution in the manufacture—a new departure, in fact, which bids fair to alter the whole complexion of the industry.

It is this circumstance, no doubt, which has primarily led to the publication of this new edition. During the last few years there has been an enormous development of the manufacture of sulphuric anhydride, and oil of vitriol itself is being made in increasing amounts by contact-processes. It is commonly believed that the chamber process is doomed. Perhaps it is. But threatened industries, like threatened men, occasionally live long. Indeed, it is Dr. Lunge's opinion that the old lead-chamber will in all probability still yield the principal supply of ordinary sulphuric acid for many years to come. It is interesting to see how, indeed, the more modern processes have indirectly afforded a fresh lease of existence to the older one. The lead-chamber with all its appurtenances is too costly a plant to be lightly discarded, and so long as it can be kept going at a profit, so long will it continue to be used. The manufacture of oil of vitriol by the chamber process is one of those highly developed industries in which, by reason of its magnitude, small economies are all important, and, as Dr. Lunge's book shows, it is only by constant vigilance to prevent waste, and by promptitude to make use of improvements, that it can stave off what some people regard as its inevitable doom.

The compiler of a work of this character who seeks to achieve what Dr. Lunge defines to be his purpose—namely, to furnish chemical manufacturers with a trustworthy guide for actual practice as well as exhaustive scientific and technological information for all students of this branch of industry—must be prepared to suffer many rebuffs and disappointments in his search for truth. There is an obvious reference to this fact in the allusion to the studied reticence of the great acid trusts and "the somewhat narrow-minded apprehension" which fears "that by enlightening their neighbours they might injure their own interests." Luckily for the cause of technology there are manufacturers who, in the words of the author, "are far-seeing and large-hearted enough" not to restrict their experience "within the precincts" of their own business circle. To these men—and the list is a goodly one—Dr. Lunge is indebted for much valuable information.

The interested reader will naturally first turn to Dr. Lunge's account of the so-called contact-process, the process which, as already stated, in some form or other probably marks the direction which the manufacturer of the future is destined to take. In this respect the third edition, which, *pace* Dr. Lunge, we hope does not represent the last opportunity the author will have of treating the subject, constitutes a new departure, and is perhaps its most valuable, as it is its most interesting, feature. Thanks to the special communications of nearly all those who have been mainly instrumental in developing it, and more especially of the large firms concerned, Dr. Lunge has been enabled to elucidate, for the first time, the history of this special branch of a great industry. For much of our information concerning its present state, we are indebted to the Badische Anilin- und Soda-fabrik, who permitted Dr. Knietsch to make known many details of the process in the course of his remarkable and interesting lecture to the Berlin Chemical Society two years ago. The account then given has been supplemented by new and valuable information from the same firm, as well as from other manufacturers in Germany.

As has already more than once happened in the history of technology, and especially in chemical technology, the fundamental idea on which the modern method of making concentrated oil of vitriol depends had its origin in this country. It was Davy who, in 1817, first directed attention to the occurrence of what were at one time classed as "catalytic," but are now generally called "contact," reactions—phenomena which immediately engaged the attention of his relative, Edmund Davy, and thereafter of Döbereiner and Berzelius. But what is of special interest is that some years before Berzelius published his well-known paper on catalysis, the attempt was made in this country to turn contact action to account in the manufacture of oil of vitriol. In 1831 a vinegar manufacturer of Bristol named Peregrine Phillips took out a patent for "certain improvements in manufacturing sulphuric acid, commonly called oil of vitriol, viz., firstly, causing an instantaneous union of the sulphurous acid gas with the oxygen of the atmosphere, and so save saltpetre and the cost of vitriol chambers, by drawing them in proper proportions, by an air-pump or otherwise, through an ignited tube or tubes of platina, porcelain, or some material not acted on by heated sulphurous

acid gas, in which are fine platina wire or platina in any finely divided state. The sulphuric acid formed is absorbed in a lead-lined tower, filled with pebbles over which water is made to trickle down."

With reference to this patent Dr. Lunge writes:—

"Undoubtedly we have here the fundamental features of the contact-process as now employed, and Peregrine Phillips must be called its inventor in the same way as Dyar and Hemming are the inventors of the ammonia-soda process. The history of both inventions presents some common features. Made and patented in England, within a very few years of each other, by persons otherwise absolutely unknown, evidently neither trained chemists nor practical manufacturers in their respective lines, they remained almost unnoticed in the country of their birth; they were taken up in foreign countries, at first by men of science, afterwards by manufacturers, but only after having suffered many checks were they brought to full technical success, both abroad and in England, after an almost equally long interval during which all attempts in that direction were judged hopeless."

There is no "tariff-wall" against the importation of English ideas into Germany. "Almost immediately after the publication of Phillips's patent two German scientists repeated his experiments." These were Magnus and Döbereiner, and on their observations Kuhlmann based his patent of 1838. Three years before this time Clement-Desormes was reported to have written, "I am convinced that in at most ten years it will be possible to make sulphuric acid on the large scale from its constituents without lead-chambers, nitric acid or nitrates." Events somewhat belied this confident prediction. What, however, was not possible during the first half of the last century was found to be perfectly practicable during the later years of the second half.

The space at our disposal precludes any attempt to show in detail how this result has been accomplished. All the main facts are set out in Dr. Lunge's account and in the interesting communications from the Badische Anilin- und Soda-fabrik, the Höchst Farbwerke, from the Schroeder-Grillo firm, the Mannheimer Verein, and last, but not least, in the account of the process as gradually developed under the direction of Clemens Winkler at Freiberg. Together the whole story constitutes one of the most interesting chapters in the history of the development of the manufacture of an article the production and consumption of which have been held to be a measure of the degree of a country's civilisation.

RELIGION, LIFE AND GENIUS.

Grundriss der Religionsphilosophie. By D. Dr. A. Dorner. Pp. xviii + 448. (Leipzig: Verlag der Dürr'schen Buchhandlung, 1903.) Price 7 marks.

Gesammelte Aufsätze zur Philosophie und Lebensanschauung. By Rudolf Eucken. Pp. 242. (Leipzig: Verlag der Dürr'schen Buchhandlung, 1903.) Price 4.20 marks.

Friedrich Nietzsche: sein Leben und sein Werk. By Raoul Richter. Pp. vi + 288. (Leipzig: Verlag der Dürr'schen Buchhandlung, 1903.) Price 4 marks.

THE author of the "Grundriss der Religionsphilosophie" brings to his exposition a wide knowledge of the literature of the subject, and a very comprehensive grasp of the forms which religion has assumed in various countries and at different stages of its development. This preliminary mastery of the subject shows itself, not only in the mass of material actually used, but also in the tone of the book; it is marked by a gratifying breadth of treatment. After an introduction on the place of a philosophy of religion in a general scheme of philosophy, there follows a lengthy sketch of the phenomenology of the religious consciousness. From this the author proceeds to the metaphysic of religion, dealing with the existence, essence and actuality of God. This forms the second division of this part; the third is devoted to the psychology of the religious subject, to belief and certainty. The second part is concerned with outward expressions of belief, and deals historically and critically with various developments, from sacrifice to prayer and contemplation, on what may be called the subjective side, and, on the objective side, with local cults, feasts, and symbols. The section concludes with discussions on the relation of religion to morality, knowledge and art. Finally, the laws of the religious life are briefly discussed.

This programme will indicate the comprehensiveness of the author's treatment. The book attains unity in its multiplicity by virtue of the leading idea round which the facts are grouped. Religion, in its widest sense, is taken to be the spiritual life of the individual. As such we expect to find it subject to development; progress is as possible here as elsewhere, and, in fact, the history of the forms of religion shows a gradual purification and emancipation advancing with the gradual refinement of experience. The goal is a union of God and humanity; the end must not be in abstractions, but in the concrete realisation of unity in life and purpose, for which, as for the unity of the world as object of the sciences, the reality of the Divine immanence is the only true ground.

To a great extent this is a position which most thinkers could accept, with the exception of one point. The distinction between the theological and non-theological philosopher rests finally on the view each takes of his ultimate. The author seems well aware that this is the crux; he expressly avoids pantheism, and would assert the rights of the individual. But what, then, is the relation between God and the individual? The answer seems inadequate in so far as certain theological aspects of God are assumed, while no proof is given that contradictions must be unified or that a unity for us can only be grounded in a unity that is for itself. Here the religion and the philosophy make a compromise not altogether unfamiliar. We regret that we cannot follow the author here; others may succeed better, and certainly no one will fail to see that his book is a valuable contribution toward a philosophical treatment of religion.

The essays and addresses of Rudolf Eucken were well worth publishing in book form. They fall into three classes. The first group deals with political philosophy. The author is mainly interested in the opposition of mechanism and spirit which is characteristic of the present age. Man, striving to subdue nature, builds up a vast mechanism; in the human

sphere organisation runs a fervid course; the watchwords are work, efficiency, achievement; the demand is for uniformity; the world is more and more, and yet the individual does not wholly wither; the life of the spirit persists in its claim for recognition, so that there is a progressive differentiation of subject and object, leaving us with the necessity and the problem of a higher synthesis. An essay on the late lamented Finland is characteristic in its generous estimate of the meaning and value of quality as against quantity in political life.

The spirit of this first section pervades the others. The biographical studies, eight in all, range from Aristotle to Karl Steffensen. The study of Goethe is notable for its delineation of a great man, a spirit of informal vigour, broad, active, and penetrating. The discussions on religion resume the thoughts of the first section. As the world grows man seeks escape into the infinite. Religion must progress as the world develops, and so fit itself to effect that redemption of the spirit of man for which the author pleads. The concluding essay deals with the teaching of philosophy, and contains advice worthy of all acceptation.

"Friedrich Nietzsche: sein Leben und sein Werk" is a book that should prove of interest now that Nietzsche's works are being presented in a translation. The life and the work are treated as complementary aspects, a method more than usually fruitful in this case; nothing could be more illuminating for our understanding of this eccentric genius than the Wagner episode; it forms a vigorous chapter in this book, and is a concrete exposition of Nietzsche's character, more effective than any abstract analysis. The second portion of the book, dealing with Nietzsche's writings, is well developed and shows sympathy and insight. To some extent the book is an apology for Nietzsche; the author is clearly aware that not a few will approach the subject with prejudices; not a few will continue to feel that some allowance has to be made for one to whom nature denied a stable equilibrium. As the book says, Nietzsche's power lies in raising rather than solving problems. The author obscures with some partiality those elements in Nietzsche's history which show the natural bias, intending clearly to oppose his own treatment to others which have neglected the genius and made too prominent the pathology of their subject.

G. S. B.

ATOMS AND THE ÆTHER.

Hypothese zur Thermodynamik. Versuch einer leichtfasslichen Darstellung einiger Prinzipe der Molekulartheorie mit Zugrundelegung der Keplerschen Gesetze für die Planetenbewegung. By Victor Grünberg. Pp. vi+73. (Leipzig: J. A. Barth, 1903.) Price 3 marks.

THIS little book consists of a discussion of the elementary portions of the kinetic theory on somewhat novel lines; the main title is therefore misleading; it is true that the subtitle modifies one's expectations to a certain extent, but even then the contents hardly come up to what one is led to hope for. The hypothesis referred to is the following:—the structure of the ether is granular; the ether particles rotate round their axes and circulate round each other; atoms are condensed ether particles, and the circulation of the latter is therefore to be identified with the rotation of the atoms; these in their turn circulate round each other; this motion constitutes the intramolecular rotation; ultimately the molecules circulate round each other.

Four distinct motions are thus introduced, but later on (p. 41) an additional fifth motion appears, another intramolecular motion; in what respect this motion differs from the circulation of the atoms remains a mystery. The molecules (and atoms) attract each other owing to their rotations and to the streams of ether particles which are thereby set up. The centrifugal force arises from the ether pressure when the molecule is made to move in a curvilinear path; this pressure makes equilibrium with the external pressure and the molecular attractions; it is calculated by dividing the centrifugal force by the area of the sphere swept out by the molecule. When this pressure is multiplied by the volume of the sphere, the product is found to be two-thirds of the kinetic energy of the motion of circulation, and this law, which is identified with Krönig's law, is soon extended to the whole gas; incidentally we notice that the volume of N molecules is found to be N^3 times the volume of one (?). It is somewhat unpleasant to be reminded of the fact that the curvilinear motion, with its concomitant centrifugal force, does not exist in the gaseous state, the only state in which Boyle's law holds, and is confined to a state intermediate between gas and liquid, whatever that may be.

In the discussion of the adiabatic formula we obtain a momentary glimpse of Kepler's laws, which are so prominent in the title. When the gas is compressed, say to one-eighth of its volume, the distances of the circulating molecules are halved and their velocities thereby doubled: the temperature being proportional to the kinetic energy becomes increased to four times its value; substituting these results in the adiabatic formula we find for the ratio of the specific heats the value 5/3, as required by monatomic gases. We are afraid that a partial success of this kind may have induced the author to attach more value to his theory than we think it deserves.

Temperature depends originally on the rotation of the ether particles; when heat is supplied to the body its ether particles begin to rotate faster; in consequence of this (why?) their circulation, *i.e.* the rotation of the atoms, slows down; on the other hand, the intramolecular motion of the atoms increases, the rotation of the molecules, and thus their mutual attraction, diminishes, and finally the molecular circulation, on which the molecular pressure depends, increases. Obviously the situation is saved by assuming an odd number of motions which increase and diminish alternately! Can anything more arbitrary or unconvincing be imagined? If the reader thinks that this short review cannot be doing the pamphlet justice, let him try for himself.

J. P. K.

OUR BOOK SHELF.

Animals of No Importance. By D. Dewar. Pp. 113. (Calcutta and Simla: Thacker, Spink and Co.; London: W. Thacker, 1903.)

THE essays collected in this little volume have, with one exception (which made its appearance in the *Indian Daily Telegraph*), been previously before the public in the columns of the *Times of India*. Although his style is occasionally somewhat slangy, the author discourses in a pleasant and readable manner on the habits and mode of life of various living creatures commonly met with by the resident in India, inclusive of some of those to be seen on the voyage. Excluding all such animals as come under the denomination of game—whether great or small—he confines his attention to the less attractive, although in many cases by no means the less obtrusive, members of the animal world, and from this lowly aspect of his subject he has chosen the title of the volume.

As a rule, each of the various essays is devoted in the main to a particular species. One of the most amusing of the series treats of the Indian crow—the miscalled *Corvus splendens*—a bird which, despite its store of mischief, Mr. Dewar allows the possession of some redeeming traits. He can, however, scarcely find words to express his detestation of that noisome pest, the common fly—a detestation shared by all who have resided in the east. On the other hand, the spider is a creature for which the author expresses the greatest admiration, ranking its intellectual powers higher than those of ant, bee, or wasp.

Under the title of the "Malaria Middleman" will be found a good popular account of the manner in which the Anopheles mosquito conveys the malaria germ; although it would have been better had the use of "scientist" been avoided. To one sentence in another article, namely, that "dinosaurs and sea-serpents disported themselves in the ocean" (p. 62), we venture to take strong exception. Although, perhaps, one relating to the movements of the fins of flying-fishes is the only zoological observation of any importance, we may commend the work as an excellent practical example of "nature-teaching," and at the same time as showing how the enforced tedium and confinement of Indian hot-weather life may be mitigated by the intelligent observation of the ways of the uninvited denizens of the bungalow and its immediate surroundings. R. L.

Farming. By W. M. Tod, M.A. With illustrations by Lucy Kemp-Welch. Haddon Hall Library. Pp. vi+268. (London: J. M. Dent and Co., 1903.) Price 7*s.* 6*d.*

THE Haddon Hall Library has hitherto dealt only with various branches of sport; its incursion into the serious domain of agriculture is therefore rather a novelty, but as Mr. Tod indicates in his opening chapter farming is something more than a business. There are probably few men who have not deep in them the desire to cultivate a plot of land or to breed some kind of animal; it is a form of atavism, civilised man gets his amusement from the pursuits out of which he dragged a hard living in the early world, and farming, like shooting and fishing, has long been the rich man's recreation. The professional can still make a living by it, but the amateur often finds his farm little less costly than his shoot. It would be hardly fair to Mr. Tod to say that his book is intended for the latter class of readers; clearly he has in mind the man to whom farming is bread and butter, but he is very sure that if the farmer sometimes finds the butter spread too thin he may look for abundant compensation in the pure joy of life on the land.

Mr. Tod's book then differs from the ordinary textbook of agriculture in treating his subject from a somewhat more generalised and human point of view; he deals with the functions of the soil, the principles of tillage, manuring and cropping, live-stock, and the system on which a farm should be managed, without any elaboration of detail, but with an intelligent appreciation both of the scientific basis of agriculture and of the other considerations which must regulate its practice. Here and there his statements and recommendations are open to criticism; in a country so diversified as Great Britain, the routine of management must change with the shifting conditions of climate and soil, but in the main the book presents a very sound picture of the farming of the midlands and east of England. Mr. Tod's experience is sufficient guarantee that the book is practical; at the same time he is no blind follower of the old paths, but is insistent that agriculture, to be successful, must adapt itself to the altered state of our markets since the great tradition of British farming was established.

The book is clearly and enthusiastically written, and we can cordially recommend it either to the man who has a little place in the country and wants to do something more than blindly follow the lead of his bailiff, or to the general reader interested in the land and desirous of understanding its great industry. To the young landowner or to the boy who is anxious to take up farming as his walk in life the book will give an excellent picture of the work of a well managed farm, and will serve as an inspiriting introduction to a more technical study of the subject. Like all the volumes of the Haddon Hall series, the book is charmingly produced, well printed on good paper, and with some illustrations by Miss Kemp-Welch which catch the true spirit of the English country-side. A. D. H.

Queries in Ethnography. By Albert Galloway Keller, Ph.D. Pp. ix+77. (London: Longmans, Green and Co., 1903.) Price 2*s.* net.

DR. A. G. KELLER'S small book of questions in ethnography is intended for the use of the "intelligent and partially instructed layman." The specialist, he informs us, needs no such manual, and the utterly uninstructed are unfitted to use one with discrimination and result. We agree with him. The 912 questions comprise a very wide range of ethnographical inquiry under the following heads:—(1) maintenance; (2) perpetuation; (3) gratification; (4) religious and superstitious ideas and usages; (5) the societal system; (6) contact and modification.

The system followed has been that developed by Prof. Sumner, of Yale University, and the questions evidently are based also on the admirable "Notes and Queries on Anthropology" edited by Dr. J. G. Garson and Mr. C. H. Read, and on the set of questions issued by Dr. J. G. Frazer. Not one of these books has been written by a field ethnologist, and it is perhaps doubtful whether a field ethnologist would write such a book, as the answers given to such questions by the collector are apt to be snippety, and, with the view of answering the question succinctly, he would be inclined to leave out other descriptive matter which did not appear to be relative to the particular question, but which might be, nevertheless, of supreme importance. Dr. Keller asks "exactly what is meant by 'father,' 'brother,' 'son,' if they do not correspond to our own terms?" This sort of questioning is of little real value; the only satisfactory method is the genealogical one devised by Dr. Rivers (*Journ.* Anthrop. Inst., vol. xxx. p. 74, 1900). Nothing is said about the value of obtaining information concerning different schools of decorative art and the significance of the designs.

Doubtless Dr. Keller's little book will prove of con-

siderable service. Practically all one can say to a traveller is that he should collect full information about everything, and books of this kind are valuable in suggesting topics for inquiry.

Catalogue of the Lepidoptera Phalaenae in the British Museum. Vol. iv. Catalogue of the Noctuidæ in the Collection of the British Museum. By Sir George F. Hampson, Bart. Pp. xx+689, plates lv.–lxxvii., and 125 woodcuts. (London: Printed by Order of the Trustees.) Price 15*s.*; plates 16*s.*

THE previous volumes of this important work appeared in 1898, 1900, and 1901 respectively, and we have now to record the publication of vol. iv., which includes the Agrotinæ, the first of the fifteen subfamilies into which the great family of Noctuidæ is divided; 1139 Agrotinæ are described in the present volume, out of the 10,000 to 12,000 known species of Noctuidæ.

As the Agrotinæ are well represented in Europe and North America, this volume will perhaps appeal to a larger number of lepidopterists than its predecessors, which treated of more showy, but principally tropical, moths. For the plates of Agrotinæ trichromatic photography has been employed, as more suitable to represent the generally dull colours of the Noctuidæ than chromolithography, which is considered better adapted to bright coloured moths, such as Arctiadæ.

Most of the leading lepidopterists of Europe and America have helped to make Sir George Hampson's work more complete by the contribution of specimens, or coloured photographs of unique types, and the loan of co-types.

Descriptions of the known larvæ of Agrotinæ are added from various authentic sources, those of North American species being mostly contributed by Dr. Harrison G. Dyar.

The general arrangement of the book is in all respects similar to that of previous volumes, and the execution of the plates is excellent, though one or two figures may perhaps be somewhat undercoloured—not a very serious point, however.

There are small matters on which we think information, when attainable, might have been added, such as the elevations between which mountain species occur (which is only rarely mentioned) and the latitudes at which Arctic species have been found.

As we may reasonably assume that the increase of our knowledge of moths will be still more rapid in the future than it has been in the past, we can hardly expect Sir George Hampson to complete the Noctuidæ in less than ten or twelve volumes. At a rough estimate it is probable that out of the 1139 species described in vol. iv. less than 300 may have been included in Walker's catalogue of 1856–1866. Rather more than 100 species of Agrotinæ have been described by Sir George himself, either for the first time in the present volume, or in previous publications.

Proceedings of the London Mathematical Society. Vol. xxxv. Pp. 476. (London: Francis Hodgson, 1903.)

A SPECIAL interest attaches to the present volume from the fact that it marks the retirement from the secretaryship of Mr. R. Tucker after thirty-five years of office. Mr. Tucker was elected a member of the Society on October 16, 1865, and two years later he succeeded G. C. de Morgan as secretary. Mr. Tucker has been responsible for the greater part of the editorial duties connected with the issue of the *Proceedings* from part xii. onwards, and he has succeeded in producing a series of English mathematical transactions of which he may well feel proud.

Among the subjects treated in this volume we note Dr. Hobson's presidential address on the infinite and the infinitesimal in mathematical analysis, and papers by Mr. Conway on light propagation in a uniaxial crystal, by Prof. A. C. Dixon on summation of series and expansion of functions, by Prof. Hill on power series, by Prof. Lamb on wave motions, by M. Picard on existence theorems for differential equations (in French), by Mr. Whittaker on harmonic analyses, by Mr. W. H. Young on sets of points and intervals, and many other papers of equal interest.

Insist on Yourself. The only Law of Success. Pp 45. (London: Gay and Bird, n.d.) Price 1*s.* net.

THIS little book is intended to set forth concisely many of Emerson's utterances on the importance and power of individuality. The "thoughts" selected are attractively arranged and nicely printed.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Unusual Sky Colours and the Atmospheric Circulation.

PROF. F. A. FOREL writes me concerning my letter in vol. lxviii. p. 623, that although he did not himself observe the coloured ring around the sun prior to the first of last August, yet he has been informed that it was seen in Europe much earlier. The observers and dates quoted by M. Forel, arranged by localities from north to south, are as follows:—Director Rykatcheff, of the Central Physical Observatory at St. Petersburg, noted an opalescent veil surrounding the sun on October 5 and November 9, 1902, January 21, February 10, 18 and 23, March 17, April 5, May 29, and July 26, 1903. Dr. Busch, at Arnsberg, Westphalia, saw the same thing on November 19, 1902, March 21 and 22, 1903, and Prof. Wolf, at Heidelberg, during January, 1903. Dr. Maurer, at Zurich, observed the ring also in January, on March 27 and 28, June 7, 8, 9, and at the end of July, 1903. Therefore, M. Forel says, very properly, that since the phenomenon was observed practically simultaneously in Europe and America, no hypothesis as to why it appeared first in the last named country is needed. While admitting the truth of the statement, I would remark that a faint whitish ring around the sun was recorded by me here as early as June 26, 1902, although it was not noticed again until the close of the year. The equally early appearance over southern England of a large brownish corona, which became smaller but more conspicuous during the summer and autumn of 1902, is described by Mr. T. W. Backhouse in NATURE (vol. lxvii. p. 174).

M. Forel pointed out in the *Comptes rendus* of the French Academy of Sciences for August 10 that in view of the intermittent character of the brilliant colours of the western sky after sunset during the preceding year, produced, he assumed, by the breaking up of the continuous ring of volcanic dust into separate cloud masses which passed successively over Europe, it became of interest to ascertain whether the present Bishop's ring, unlike its predecessor, was always visible in favourable circumstances. The data mentioned, as subsequently sent M. Forel, proved that the new Bishop's ring was visible only at irregular intervals, as he had surmised. Now, if this phenomenon, as well as the discontinuous sunset glows, were caused by the passage of isolated masses of volcanic dust, it seems possible, by comparisons with observations at distant stations, not only to trace the direction of their drift, but also to determine their approximate velocity. Accordingly, the records at Blue Hill of the occurrence of Bishop's ring and of abnormal glows after sunset during the past year were examined, and the tendency of both phenomena to occur intermittently, but not necessarily simultaneously, was established, even though the transparency of air remained nearly constant.

On comparing these days with those on which Bishop's ring was stated to have been visible at Zurich, and with the dates, from M. Forel's paper, of abnormal sunset glows seen at Morges, it was found that the successive appearances of the respective phenomena occurred here about twenty days later than they did in Switzerland. Of course, the weather conditions at single stations introduce irregularities, so that the conclusion must be regarded as uncertain, but supposing it to be approximately correct, since the stations used lie nearly in the same latitude, and we can assume that the drift of the elevated dust-clouds was from west to east, their velocity in passing around the globe, from central Europe to the eastern United States, was about 30 miles per hour, or a rate considerably less than that found from trigonometrical measurements to be the velocity of the highest ice-clouds.

In the case of the great Krakatoa eruption in 1883, the speed of the ash-cloud as it circled the globe from east to west along the equator, and its slow diffusion toward the poles, was determined from the observation of the successive appearances of coloured suns and brilliant sunset glows in different parts of the world, collected by the Royal Society's committee appointed in 1884. The assistance in solving the problem of atmospheric circulation which a knowledge of the drift of dust ejected into the upper atmosphere by volcanoes situated in the tropics might furnish would certainly justify obtaining all available data bearing on the march of the abnormal sky colours. Mr. Clayton, of this observatory, began the collection of such data some time ago, but was deterred from continuing the work by reason of the difficulty in obtaining definite information. A task of such magnitude belongs properly to a commission possessing the necessary facilities for collecting and discussing the material, so it is hoped that an organisation like the Krakatoa Committee, the admirable report of which was published in 1887, may undertake the study of the recent and present remarkable sky colorations, probably occasioned by the eruptions in 1902 of the volcanoes in Martinique and St. Vincent.

A. LAWRENCE ROTCH.

Blue Hill Meteorological Observatory, Hyde Park, Mass., U.S.A., December 11.

Internal Oscillation in the Waters of Loch Ness.

I WOULD beg a little space in your columns to direct attention to some of the conclusions which I draw from temperature observations taken last summer in Loch Ness.

Routine observations have been taken at the south-west end of the loch several times a day since the middle of July, and I find that the temperature at any depth between 100 and 300 feet changes with time in a markedly periodic fashion, the duration of a period being approximately three days. At about 200 feet the difference between a maximum and a minimum is something like 5° F. At greater depths the temperature change is less, but of the same period and the same phase. At depths less than 200 feet also the temperature change appears to fall off in magnitude whilst retaining the same period and phase, but here there appear to be other changes more or less obscuring the simple periodic variation. Diagram 1 gives a few observations at 200 feet.

I conclude from these observations, and others taken at different parts of the loch, that there is an internal oscillation in the waters—an internal seiche, similar to the swinging which may be set up in the interface between oil and water lying the one above the other in a trough. For such a motion we require liquids of different density lying one above the other; in the loch the upper waters being warmer are lighter than the lower strata, and I think it probable that the region where the temperature changes most abruptly acts as a surface of separation, and is comparable with the interface between the oil and water in the simple arrangement just mentioned. In Diagram 2 I have tried to illustrate the motion. The shaded portion is intended to represent the warmer water, and the hard line the region where the temperature changes most abruptly. Rough calculations on the assumption that the swinging is of this nature give the period of the order observed. A very remarkable point is the large amplitude of the vibration. At the ends of the loch the isothermal surfaces suffering the greatest displacement may move through as much as 75 feet.

The observations make it probable that this swinging is started by gales and strong winds. Winds produce a slope of the upper isotherms down towards the lee end of the loch, and the stronger the wind the deeper is this effect felt. So that strong winds are able to displace the relatively deep

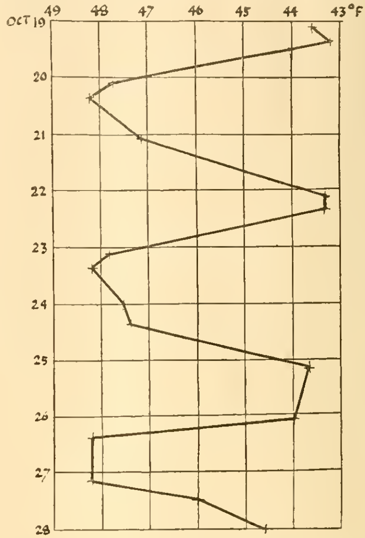


FIG. 1.

isotherms in that region where they act as an interface, and on the wind falling the isotherms swing back and continue to swing freely with a natural period.

Unfortunately it is necessary to wait for the return of summer before more observations can be made bearing on the subject, as the waters are now of almost uniform temperature.

I believe I am right in saying that such a phenomenon had up to this never been even suspected by limnologists.

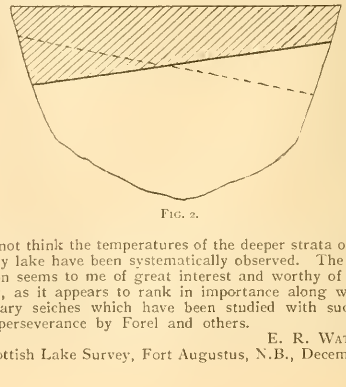


FIG. 2.

I do not think the temperatures of the deeper strata of water in any lake have been systematically observed. The phenomenon seems to me of great interest and worthy of careful study, as it appears to rank in importance along with the ordinary seiches which have been studied with such care and perseverance by Forel and others.

E. R. WATSON.

Scottish Lake Survey, Fort Augustus, N.B., December 12.

A GREAT RELIGION.[1]

If any proof were needed of the value of the comparative method in historic research, it is afforded by these handsome volumes. The science of comparative philology produced that of comparative mythology, and the establishing of a system of analytical study of myths and folklore, which extracted meaning from the meaningless, and turned the mere fable into precious fragments of historic record.

The study of myth and folklore revealed certain laws that were common to most systems by which the growth and development of a religion could be studied. First, it established the fact that a religion, be it the most elementary beliefs of a savage people or the fully developed creed of dynastic Egypt or Chaldea, or the sacerdotal system of the Hebrews, was essentially the product of the human mind—religion becomes, therefore, a branch of anthropology, and requires to be studied by the methods of that important science.

No religion of the ancient world so much demands to be studied by the anthropological method as that of Egypt. Its antiquity far exceeds that of all other nations, for many of its component elements belong to the prehistoric age. Viewed as a whole, it is a perfect conglomeration of strange and contradictory elements. Grossly savage beliefs of animal worship and cannibalism are found side by side with the most simple monotheism, and magic and demonology with an elaborate system of eschatology which in the latest times exercised a powerful influence on that of Christianity. Not only was the student faced with this confusion of elements, but there was another serious difficulty to encounter. Unlike the great Aryan or Semitic religions, the Egyptian religion possessed no canonical books like the Vedas or Avesta or the Hebrew scriptures. The Egyptians were not a literary people; there was a scribe caste, powerful through its priestly and official associations, but essentially a caste. Unlike the Babylonians, they had no national epic poems, no exegetical literature.

The only work which in any degree could be considered as the sacred book of the Egyptians was the "Book of the Dead," a mosaic of material of various ages and sources. The student, therefore, who would solve the riddle of the Sphinx and reduce chaos to system and order, must be a bold man, and prepared to face much labour and study. Great scholars had already laboured in the field. Dr. Heinrich Brugsch, in his work "Religion und Mythologie, der Alten Ægypter," had attempted to set forth the chief features of this wonderful religion; he had, however, been hampered by his material. The fine editions of the "Book of the Dead," such as the Ani and Nu papyri of the Theban age, were unpublished, and he had recourse chiefly to late material of the Ptolemaic age, a time when the Egyptians themselves knew little of their own religion. Moreover, Brugsch approached the subject from a classical, Aryan, and philosophical point, a method totally unsuitable for a religion with an African vocabulary. As Dr. Budge justly remarks, "No African language is suitable for giving expression to theological and philosophical speculations, and even an Egyptian priest of the highest intellectual attainments would have been unable to render a treatise of Aristotle into language which his brother priests without teaching could understand." M. Maspero was the next savant who essayed the task, and he had older material, and was the first to apply the anthropological method. He recognised the savage cults in animal worship and magic, and in the pyramid texts of the sixth dynasty.

The astonishing progress of discovery in Egypt during recent years has given an enormous retrospective enlargement to our knowledge of human life in the Nile Valley. Not only is the historic age known with an astonishing degree of detail to its very threshold, but our knowledge now extends far into the dark regions of the prehistoric.

From the graves on the edge of the Lybian plateau we gather not only the records of the life on earth of these people, but also the evidence of their simple creed and hopes of a life hereafter. Here, then, we must look for the beginnings of the religion of Egypt and the birth of the gods. It is now possible to ascertain the conditions of the environment in which the first elements of Egyptian religion grew up.

At the commencement of his work Dr. Budge deals with one of the greatest difficulties of the Egyptian religion—the problem of animal worship. At the time of man's first advent into north-east Africa and the Lybian plateau, the Nile valley presented a very different appearance from that of to-day. Banked by the Arabian and Lybian hills, the latter wooded and swarming with animals, and with great swamps and marshes full of Amphibia and serpents, &c., it was very different from the Egypt of historic times. Man found himself compelled to struggle for existence, not only with human foes, but also with a host of hostile animals. The fear of these produced a worship of them; we have a similar cult in Chaldea in the animal demons, lions, leopards, serpents, scorpions, &c. Man, however, soon demonstrated his superiority to the brute creation; some he killed in self-defence, some he domesticated or rendered serviceable to himself. The Egyptian of these prehistoric times was a cannibal; proof of this is shown by the long and valuable passage describing King Unas hunting, killing and eating the gods. Dr. Budge clearly shows the argument on which cannibalism was based. By eating the hearts and livers of men or gods the king acquired their powers; so also with animals. How early the Egyptian attained to the idea of some immortal element in man we cannot say, but we can see from the burials of the Neolithic age that it was fully developed then. This developed the belief in the god-man or god-king who lived and died and became immortal. He had as Unas the powers of man and of animals, and thus man worship and animal worship were fused by placing the animals' heads on human bodies, as the Babylonians placed human heads on animal bodies. The belief in the god-man—the anthropomorphic cult became the indigenous creed of Egypt—in the form of the worship of Osiris, and Dr. Budge's arguments for its north-east African origin are most convincing. Whatever other forms of religion were developed in Egypt or introduced from without, it remained the faith of *the people*, and continued so until the god-man Osiris became absorbed into the man Jesus Christ. It was the golden thread which ran through the tangled skein of religious life in Egypt for many thousands of years. In elucidating this fact, Dr. Budge has, as it were, established a base line for his study of all the other varied elements in this complex creed. These most important other elements are fully dealt with, but space will only allow us to deal with two, the Ra cult of Heliopolis and the worship of Horus the Hawk, "sky god" and "his blacksmith followers" with its centre at Edfu.

The solar cult of Ra-Tem of Heliopolis shows many traces of affinity with the solar cults of Asia, and this may be accounted for by the position of Heliopolis, but there is a preponderance of native elements. By many it has long been regarded as *the* religion of

[1] "The Gods of the Egyptians: Studies in Egyptian Mythology." By E. A. W. Budge, Litt D., D.Litt., &c., Keeper of the Department of Oriental Antiquities in the British Museum. 2 vols. Pp. xvii+525 and viii+431; with 98 coloured plates and 131 illustrations. (London: Methuen and Co., 1904.) Price 3*l*. 3*s*. net.

Egypt, owing to the immense power it attained when blended with that of Amen of Thebes, and administered by the most powerful priesthood the ancient world ever produced. Dr. Budge, however, very clearly demonstrates its position as the religion of the court and aristocracy of Egypt, as that of Osiris was the creed of the people. From an early period there was a fusion of the two creeds, and with the Theban school this was carried to the extreme, where Amen Ra assumes the function of Osiris and all the other gods as well, but with the fall of the ambitious hierarchy the old creeds once more asserted their power. This portion of the book is a most interesting and valuable account of one of the greatest religious movements of ancient times.

The revival of the Heliopolitan ritual, and especially the teaching as to the Heaven of the victorious Osirian, is very fully described, and there is here matter of immense value. Here the deceased who has become justified "becomes god the son of god," he takes his seat by the side of God, and eats of the Tree of Life, which is in the midst of the Field of Peace. He lives on light, becomes a being of light, and, as Dr. Budge points out and we must add very quietly, that as this cult was known among the people of Lower Egypt until two centuries after the Christian era, we have here the source from which the writer of the Apocalypse drew his description of the life of the Christian who had "overcome" the world. There is material under the study of the important mother goddess cults which should certainly attract attention from the New Testament critics, for here we have the basis of the Theotokos controversy. This is not the place to discuss theology, so we pass to the more interesting subject of the worship of Horus Beḥutet, the opponent of Set, with his curious guild of "Blacksmiths." Dr. Budge's remarks on this subject are of importance, as they show how often history is found interwoven with myth. Essentially a solar myth, there is interwoven with it the story of the invasion of Egypt from the south by a superior race who used iron or metal weapons against the flint weapons of the aborigines. To quote Dr. Budge:—

"It is of course impossible to say who were the blacksmiths that swept over Egypt from South to North, but the writer believes that they represent the invaders in predynastic times who made their way from a country in the East, by way of the Red Sea, by some road across the eastern desert. They brought with them the knowledge of working in metals and of brickmaking, and having conquered the indigenous people of the South, that is those around Edfu, made that city the centre of their civilisation."

In later times the material conflict was blended with the mythic, and hence the confused legend of Ptolemaic times. Sufficient has been said to show the rich material Dr. Budge has collected in these two great volumes, but we can only dip into them in this review. The valuable analysis which Dr. Budge gives of those strange works the "Book of the Tuat" and the "Book of the Pylons" will be welcome, for hitherto no authoritative English description of these works has been accessible. The curious illustrations of the journey of the sun through the night hours, which are found on the sarcophagus of Seti I. in the Sloane Museum and in the royal tombs of the nineteenth and twentieth dynasties, certainly depict all the horrors of hell to the simple and uninitiated. The works were, however, essentially sacerdotal, and inscribed in places not accessible to the people, so whatever their teaching might be, it did not affect the popular religion. Dr. Budge is probably right in denying the theory that the Egyptians believed in eternal punishment, but they supplied all the material for a most elaborate illustrated edition of the Egyptian inferno to those who held that doctrine. Hence we find the early Christians giving such vivid descriptions of the fate of the damned.

There are some points on which, however, we must differ from the author. After the very lucid description which he gives of the Egyptian Tuat or Land of Night, he gives us a most valuable excursus on the Hebrew Gehenna and the Babylonian Hell, and would attribute the Rabbinical ideas to Egyptian influence. Great as was the influence of Egyptian theology on early Christianity, the Apocalypse and Coptic writings, it is very doubtful if it attracted the Jewish mind. The Seven-headed Serpent of Revelation is the Serpent of the Week of the Babylonians with seven heads and tails—certainly not the seven-headed serpent of the Egyptians.

In conclusion, we must give a high word of praise to the preparation of the work; the beautiful plates and illustrations, the various tables and indices, render it a work that should win the gratitude of all Egyptologists, and add still more to the writer's reputation as an indefatigable worker and a painstaking scholar.

FIG. 1.—Horus of Beḥutet Armed (Edfu). From "Gods of the Egyptians.")

SCIENCE IN SOFT RAIMENT.[1]

IN these six agreeable volumes there is an extraordinary family likeness, which the authors themselves perhaps would be very unwilling to recognise.

[1] "Wild Nature's Ways." By R. Kearton, F.Z.S. With 200 illustrations from photographs taken direct from nature by Cherry and Richard Kearton. Pp. xvi+296. (Cassell and Co., 1903.) Price 10*s*. 6*d*. net.

"A Little Brother to the Bear, and other Animal Studies." By William J. Long. Illustrated by Charles Copeland. Pp xix+280. (Boston, U.S.A., and London: Ginn & Co., 1903.) Price 7*s*. 6*d*.

"Wee Tim'rous Beasties; Studies of Animal Life and Character." By Douglas English. With 150 illustrations from his photographs of living creatures. Pp. vi+223. (London: S. H. Bousfield and Co., Ltd., 1903.) Price 5*s*. net.

"Popular Natural History of the Lower Animals (Invertebrates)." By Henry Scherren, F.Z.S. Pp. 288; with 168 illustrations. (The Religious Tract Society, 1903.) Price 3*s*. 6*d*.

"Nature's Riddles; or the Battle of the Beasts." By H. W. Shepheard-Walwyn, M.A., F.Z.S., F.E.S. With coloured plate and over 100 illustrations by the author. Pp. xvi+295. (Cassell and Co., 1903.) Price 6*s*.

"Nature—Curious and Beautiful." By Richard Kerr, F.G.S., F.R.A.S. With sixty-nine illustrations from drawings made by the author. Pp. 274. (London: The Religious Tract Society, 1903.) Price 3*s*. 6*d*.

Even "the point of view," on which Mr. Long insists, does not very greatly vary. From book to book we come across the same animals, house-mouse and dormouse, sparrow and kingfisher, fox and squirrel, remarkable shells and strange leaf-insects. The problems are the same—the boundaries of instinct and reason, the methods and reality of protective resemblance, and all the general mystery of life. If Mr. Shepheard-Walwyn aims at inducing his readers "to study for themselves wild nature and her wonderful ways," Mr. Kearton makes the same appeal on his title-page. Mr. Walwyn gives his book an alternative title, "The Battle of the Beasts," his beasts proving in the sequel to be chiefly birds and insects. In like manner Mr. Douglas English chooses for one of his "wee tim'rous beasties" the purple emperor, although among butterflies *Apatura iris* is not tiny, and in Mr. English's own account of it is not timorous. He describes it as displaying while still a mere caterpillar "paroxysms of fury," and by help of its hard and formidable horns successfully repulsing the attacks of an ichneumon-fly. He leaves it to us in the end as a vision of triumphant beauty on its nuptial flight soaring boldly into the empyrean.

The three authors above mentioned compete with one another in a very delightful manner, their illustrations being evidently the result of extreme ingenuity and skill in the art of photography. Mr. Kearton and others are now making known the devices, sometimes rather comical, by which the wary children of the wilderness have to be outwitted. It is not so easy to win the grace of naturalness in the portrait of a willing sitter. One can scarcely, therefore, expect a cool and unconstrained demeanour from creatures shy and nervous, surprised in their most secluded haunts, and expecting only that they and their young ones are to be robbed and murdered by the camera-fiend. That centaur-like compound of man and machine has in consequence to manage its movements with consummate caution and hours of patience. The plan of stretching a wire, by stepping on which the wild creature will itself open the magic shutter, is no doubt hopeful. But there are ledges of precipitous rocks, accessible only at serious risk of life or limb, to which it is as difficult to attach an electric wire as to put salt on the tail of a hunted bird.

Fig. 1.—Dormouse. (From "Wee Tim'rous Beasties.")

The unelaborate care with which nature moulds and paints her savages, the mild and the merciless alike, so as to make them undistinguishable from their surroundings, has a singular effect on the pictorial success of a photograph. It might almost be said that the better it is the less we like it. The finish and excellence of the scene that is reproduced in all its minutiæ often beguiles the eye to such an extent that it becomes nearly as great a puzzle to find the bird, the nest, the caterpillar or the butterfly, the spider and the spider's web in the picture as it was to detect the real objects in their actual environment of reeds and moss and grass, dead leaves and bare twigs, or a medley of sticks and stones. In this respect Mr. Long in his humorous and entertaining book has a certain advantage. With the help of a clever artist he can make his incidents highly dramatic. He can emphasise what points he pleases in the life and actions of his coons and cats, moose and mink, fat familiar toad or woodcock with an astounding genius for surgery worthy of Hutton the bone-setter.

All the writers seem to agree in lamenting "That villainous saltpetre should be digg'd Out of the bowels of the harmless earth," to destroy their particular favourites, though they cannot help gloating over the hundreds of flies and other insects destroyed by toad or sparrow. But Mr. Long goes a step further in the cause of humanity. It is not only the ordinary gun of which he deprecates the use. The photographic gun must also be tabu. He celebrates the man "who goes to the woods for rest and for letting his soul grow," who is "content just to see and hear and understand," who "has no fret or sweat to get the sun just right and calculate his exact thirty-foot distance and then to fume and swear," as Mr. Long has "heard good men do" (though that, of course, is incredible and a mere aural delusion), "because the game fidgets, or the clouds obscure the sun, or the plates are not quick enough, or," &c. Thus do we scoff at other men's pursuits, and at our own! Mr. Kerr in turn might well laugh to scorn Mr. Long with his canoe and his camp, and his creeping up "through the brûlée to where bear and her cubs are gathering blueberries in their greedy, funny way." What if they should suddenly take a fancy to gathering Mr. Long?

Mr. Kerr says of his own excellent studies, "wherever possible I have made my sketches direct from Nature," with this ingenuous finish to the sentence, "and for this purpose I have spent many hours in the Natural History Museum, Cromwell Road." There, to be sure, no living bears are likely to quicken the pulse or to make the directness of nature-study over exciting. But in compensation, as Mr. Kerr's book will help its readers to perceive, our National Museum contains many of the most wonderful specimens that the globe produces, and though the game is dead and the life is still, they are trophies of all that is most artful and most artistic in nature's handiwork. If, however, the illustration of the watering-pot shell is faithfully reproduced, the example copied cannot be a very good one, since it shows far too faintly the two rudimentary embedded valves to which attention is directed in the text. Protective resemblance is finely exemplified in Mr. Kerr's figure and description of the leaf-butterfly, Kallima, from Mr. Rothschild's museum at Tring, and again by several figures of moths and butterflies in Mr. Walwyn's "Riddles." On the other hand, this much debated hypothesis is ill supported by the unnamed "submarine shellfish" in the latter work. There a species of Pteroceras is represented, a moderately flattened shell with seven long projecting processes, and Mr. Walwyn asks us to believe that this "mimics a crab, whose coat of mail affords him a very complete protection." The author does not trouble himself to say what crab is mimicked, or whether its coat of mail is harder than that of the Pteroceras, or anything like as hard. He does not say whether he ever saw a crab with its legs sprawling about in such impossible positions as the processes of the shell would represent. Above all, he seems to have forgotten that to look like a crab is the worst possible disguise to assume in the sea, unless you wish to say to the first passer-by that has a wide enough mouth, "please, come and eat me."

Mr. Henry Scherren's attractive and compendious little book stands rather apart from the rest. It aims, and aims successfully, at giving the young naturalist a pleasant idea of the invertebrates as a field of study. It is unfortunate that a wrong adjustment of the type on p. 49 has obscured the grouping of the cephalopods. The passage reads as if the second group no less than the first was subdivided into eight-armed and ten-armed species. The confusion is increased by a further accident on the following page, where the name of "the Pearly Nautilus" is attributed to the figure of "the Paper Nautilus," *Argonauta argo*, although it is

Fig. 2.—The Leaf-Butterfly. Rothschild Museum. (From "Nature—Curious and Beautiful.")

properly given later on to the *Nautilus pompilius* figured and discussed on p. 56. Such mistakes are likely enough to arise so long as publishers entertain a superstitious dread that the popularity of a book will be impaired by the introduction of technical scientific names. Alone among our authors, Mr. Kerr has been allowed to set this superstition at defiance. The public are seemingly expected to hail with delight such names as Mooweesuk and Musquash, and Chigwooltz and Unk Wunk. Perhaps they are pleasantly resonant of Longfellow's "Hiawatha." Otherwise they are no easier to remember than Linnean Latin. Mr. Long understands this, and kindly supplies a glossary, not of technical names, but of Indian and English. Hence we learn that Mooweesuk is "the coon," and that Nemox is "the fisher," but whether the world has more than one coon or more than one fisher we are left wondering, and what in the world Mr. Long's "fisher" may be remains a problem, one of nature's riddles for Mr. Shepheard-Walwyn to solve.

It may be said of all these books, though their merits are various and their individual merit unequal, that they are good both to give and to receive.

T. R. R. S.

INDIAN METEOROLOGICAL MEMOIRS.[1]

IT was only quite recently that there was noticed in these columns the volume containing the record of rainfall of each Indian station, printed in such a form that the reader could at a glance see the monthly, yearly, or monsoon fall for any year up to 1900. This important volume, published under the direction of Sir John Eliot, is now followed by another equally valuable, embodying all the pressure observations of each station for the whole period of observation up to the end of the year 1902. These pressures are all reduced to 32° F. and constant gravity (lat. 45°), but not for height above sea-level; the elevation of the cistern is, however, added in each case.

Previous to the year 1889, the monthly means given are those of the mean of the ten and sixteen hours' monthly mean, but after that year the 8 a.m. monthly values alone are employed. At the foot of each table the necessary information is given for converting one series into the other, so that no difficulty should be encountered in this respect.

As an indication of the thoroughness with which this compilation has been attended, the attention of the reader may be directed to appendix i., which contains notes on the positions of the observatories and the character of the barometric observations. Appendix ii. includes further important data, for here are collected for each station such valuable notes as makers and kinds of barometers employed, periods of use, positions, corrections to Calcutta standard, &c.

The data included in this volume refer to 121 different stations, and the records in most instances date from the year 1875.

Another memoir that has just recently been published is one which deals with the movements of the upper clouds. The observations were made at six stations, namely, Simla, Lahore, Jaipur, Allahabad, Vizagapatam, and Madras, and were recorded by means of Fineman's nephescopes, a description and illustration of which are given in the text.

The period of observation extended over the years 1895–1900, and in this volume not only is a monthly summary of the data for each of these stations inserted, but also the results of a brief discussion, and a series of twelve plates illustrating the mean directions of the different classes of clouds for each month of the year.

The following are among the chief results which have been gathered from this series of observations, but it is pointed out that a more extended series at

[1] Vol. xv., part i., Brief Discussion of the Cloud Observations Recorded at Six Stations in India. Pp. 112. Vol. xvi., part i., Monthly Normals of Air Pressure Reduced to 32° F. and Constant Gravity 45°. Pp. 184. (Published under the direction of Sir John Eliot, M.A., F.R.S., K.C.I.E., Meteorological Reporter to the Government of India and Director-General of Indian Observatories.)

twenty or thirty selected stations is desired to corroborate these facts and conclusions.

The amount of cirrus cloud is small during the rainy season in Upper India, and increases rapidly southwards, reaching a maximum in southern India.

The amount or frequency of cirro-stratus cloud is large in the dry season in northern India, and decreases rapidly southwards to southern India, where it is very small, as indicated by the Madras and Vizagapatam observations.

The amount of cirro-stratus is much smaller in the wet than in the dry season in Upper India. It is very small in the peninsula, almost as small as in the dry season. It is, on the other hand, of frequent occurrence over the area represented by Jaipur and Allahabad, and more especially in Allahabad.

Alto-cumulus cloud is a cloud of frequent occurrence in northern India throughout the whole year. It is of rare occurrence in the peninsula from November to May, and of occasional occurrence from June to October at Madras.

Cumulus and cumulo-nimbus are of frequent occurrence in the dry season at Simla, Jaipur, Vizagapatam and Madras, more especially at the two last-named coast stations, and are, in fact, the most characteristic clouds of the Indian area. They are of frequent occurrence in the wet season, more especially at the peninsular coast stations and at Jaipur and Allahabad.

It is noteworthy that cumulus and cumulo-nimbus are of much less frequent occurrence in the wet than in the dry season at Vizagapatam and Madras. The former type of cloud is also comparatively rare at Allahabad and the latter type of cloud at Jaipur in the dry season.

With regard to the directions of movements of the different types of clouds at the different seasons of the year, the maps in the volume illustrate the results most clearly. Reference may here, perhaps, be made only to the directions of the cirrus and cirro-stratus during the wet and dry seasons, and the following table sums up the information for the six stations.

Station	Mean direction of movement in			
	Dry Season		Wet Season	
	Cirrus	Cirro-stratus	Cirrus	Cirro-stratus
Simla	S. 80° W.	S. 82° W.	S. 85° W.	S. 69° W.
Lahore	S. 86 W.	S. 86 W.	S. 48 W.	N. 81 W.
Jaipur	N. 86 W.	N. 87 W.	N. 78 W.	N. 80 W.
Allahabad ...	S. 82 W.	S. 83 W.	N. 83 W.	S. 65 W.
Vizagapatam...	S. 4 W.	S. 27 W.	N. 72 E.	N. 65 E.
Madras	S. 13 W.	S. 86 W.	S. 82 E.	N. 87 E.

It will be seen that the movements of the two kinds of clouds in both seasons are practically the same in Upper or north-west India, but differ very considerably when the stations are more south.

It may further be noted that in the more northern stations the air movement as observed by the upper clouds is very steady in the direction from almost due west to east, and this is more especially so during the dry season from November to May.

During this small number of years of observation it was detected that the mean direction of the cirrus movement varied slightly in the same months or seasons of different years. This variation, as Sir John Eliot states, is almost certainly real, and represents a phase in the upper air movement over a considerable area.

Previous to these cloud observations it had been estimated on theoretical grounds that the south-west monsoon currents reach up to an average elevation of 10,000 to 15,000 feet, no actual measurements having been made. Sir John Eliot here points out that the most remarkable feature of the present cloud observations is the great variability or unsteadiness of the cloud movement during this period up to the elevation of the highest cirrus at Allahabad, in the centre or axis of the trough of low pressure. From cloud measurements made by photogrammeters at Allahabad during the wet seasons (June to September) of the years 1898 to 1900, it was deduced that the variable or unsteady movement in the monsoon trough extended "to a probable elevation of 30,000 feet at least, and perhaps even to 40,000 feet, and that the regular movement in the higher atmosphere from west to east is either suspended or occurs at a much greater elevation than in the dry season."

The important results obtained by determining the movements of the air currents at different heights by means of the observations of clouds indicate that the use of kites and unmanned balloons will perhaps prove a valuable auxiliary.

The appearance of these two important memoirs so recently after the one to which reference has already been made will give the reader some notion of the activity displayed by the Indian Meteorological Department under the distinguished direction of Sir John Eliot, and of the valuable researches which it contributes to meteorological science.

W. J. S. L.

THE FOOD AND DRUGS ACTS.[1]

THE two Parliamentary papers mentioned below, although widely different in character, are, at bottom, intimately connected with a common question, namely, the effective administration of the enactments dealing with the adulteration of food and drink.

The Food and Drugs Acts are now upwards of a third of a century old. They have been considered and reconsidered by Parliament at various times even down to the year 1899, and in the consideration have had to run the gauntlet of much deliberate obstruction from faddists, federations, and that class of free-fooders which regards any legislative interference with the buying and selling of anything of the nature of food, however bad, as noxious economic heresy, and a restriction of the free play of competition. That the Acts contain compromises, inconsistencies, and anomalies is well known to those who have anything to do with their administration. Nor has the judge-made law by which these anomalies have been interpreted tended to their smoother working; indeed, it has caused them to be absolutely inoperative in certain directions. How imperfect the Acts are is strikingly exemplified in the two papers before us.

The first, and in a sense the most important, of these is the final report of the Royal Commission appointed to inquire into arsenical poisoning from the consumption of beer and other articles of food or drink. It will be remembered that in the latter part of 1900 there occurred a serious epidemic of poisoning which was traced to arsenical contamination of beer at numerous breweries through the use of brewing sugars manufactured by a single firm in the neighbourhood of Liverpool. The arsenic was introduced into these sugars by way of a highly arsenical sulphuric acid supplied by a firm of chemical manufacturers in

[1] Final Report of the Royal Commission appointed to inquire into Arsenical Poisoning from the Consumption of Beer and other Articles of Food or Drink. Parliamentary Paper. Cd. 1848. 1903.

Final Report of the Departmental Committee appointed by the Board of Agriculture and Department of Agriculture and other Industries and Technical Instruction for Ireland to inquire and report upon the desirability of Regulations under Section 4 of the Sale of Food and Drugs Act 1899 for Butter. Parliamentary Paper. Cd. 1749. 1903.

Leeds which had been used in their production. This occurrence was attended with serious consequences, and caused such widespread alarm that it was deemed expedient that a Royal Commission should issue to ascertain the amount of the sickness and death attributable to poisoning by arsenic, and to consider by what safeguards the introduction of arsenic into articles of food or drink can be prevented.

In their first report the Commissioners dealt with the immediate question which led to their appointments, and made certain recommendations with the view of strengthening the hands of the Inland Revenue Authorities in preventing a recurrence of such a catastrophe as that which occurred in the autumn of 1900.

In their second and final report the Commissioners state in the outset what action they took to ascertain what became of the large stock (more than 700 tons) of arsenicated glucose and "invert" remaining at the works of the firm who made it, and also what became of certain arsenicated table syrups (14 tons in amount) which they had placed on the market. It is satisfactory to know that all the contaminated glucose and "invert" sugar was got rid of for purposes unconnected with food, particulars regarding each sale and the undertakings entered into respecting the use of all sugars sold being communicated to the Commission and to the Local Government Board.

As regards the extent of the epidemic, it appears from the evidence of witnesses and from information obtained from medical officers of health that the total number of persons who suffered was certainly not fewer than 6000, and probably considerably more. It is impossible to determine the number of fatal cases with any approach to accuracy. From the returns of the medical officers of health it appears that these were at least seventy, that is to say, there were seventy cases in which arsenical poisoning was entered in the death certificate as the cause of death, or was found to be a cause as the result of a coroner's inquest. These, in the opinion of the Commissioners, do not represent the total number of cases. Deaths occurring before the discovery of the cause of the outbreak were frequently certified as due to "chronic alcoholism" and "cirrhosis of the liver," and in some cases were attributed to Addison's disease and to locomotor ataxy. Other deaths were recorded as due to "alcoholic," "peripheral," or "multiple" neuritis

Not the least valuable result of the inquiry has been to bring together a series of detailed descriptions by competent medical observers of individual cases of poisoning, of different clinical types which they have distinguished, of particular symptoms met with at different stages of the malady, and of pathological changes observed *post mortem*. These descriptions form valuable material for reference and comparison, and merit careful attention.

The Commissioners are of opinion that a considerable proportion of beer brewed in some parts of the country before 1900 contained noteworthy quantities of arsenic, mainly derived from malt and from brewing sugars. It is also evident that before 1900 the degree to which beer had been liable to receive arsenic from malt must have varied greatly in different parts of England. Malt has been shown to have been subject to arsenical contamination in much greater degree when the fuel used on the kiln has been gas coke than when oven coke or anthracite has been employed. It would seem that the fact of greater prevalence of alcoholic neuritis among beer drinkers in Manchester and Liverpool before 1900, when compared with other places, is to be ascribed to the larger proportion of arsenic contained in much of the malt there used, due to the character of the fuel employed in kilning. That malt of this character will give rise to arsenical poisoning was shown by the occurrence of an outbreak in Halifax in 1902, the circumstances of which were carefully inquired into by the Commission.

Incidentally, the Commission has accumulated interesting and valuable information on the question of individual susceptibility to arsenic, on the mode in which it accumulates in human tissues, and on the ways in which it is eliminated. Arsenic was detected in sweat, in the epidermic scales which are freely shed in the condition known as keratosis, in the nails and in hair. It appears that epidermic tissues, which consist principally of keratin, have a special affinity for arsenic, and that the effect of arsenic upon nerve tissue may be related to the fact that nerve sheaths consist largely of keratin.

With regard to the suggested relation between the disease known as "beri-beri"—a disease mainly characterised by peripheral neuritis—and arsenical poisoning, the Commissioners are of opinion that such clinical, etiological and chemical data as they have been able to collect lend no support to the idea of such relation.

Much of the evidence laid before the Commission related to the relative value of different methods of estimating small quantities of arsenic in brewing materials and in food and drink generally. Indeed, there has sprung up quite a plentiful crop of literature on the subject within the last three years, and one effect of the inquiry has unquestionably been greatly to improve our analytical methods of detecting and estimating minimal quantities of arsenic. On the whole the Commission is inclined to recommend the method of comparison of mirrors, obtained either by the so-called Marsh-Berzelius method or by the electrolytic method as worked out by a departmental committee appointed by the Board of Inland Revenue.

A considerable section of the report deals with the various ways in which foods are liable to become contaminated by arsenic, and the precautions which should be taken by manufacturers to exclude it. In the greater number of cases the introduction of arsenic would appear to be due to the use of mineral acids, more particularly sulphuric and hydrochloric acid, in the preparation of ingredients of food. Arsenic may also be introduced in the mineral or organic colouring matters which may be employed to "improve" the appearance of food preparations.

The subject of malt naturally receives much attention. Although the exclusion of small quantities of arsenic from it has proved to be a matter of considerable difficulty, it is satisfactory to know that all the evidence goes to show that it is now commercially practicable to produce malt which either may be considered free from arsenic or in which the amount of arsenic is certainly less than 1/250th grain per pound. Considerations of space preclude us from attempting to show how it has been proved that access of arsenic to malt may be obviated or diminished. No doubt this section of the report will receive from those commercially interested in the matter the attention which its exhaustive treatment merits.

In the concluding sections of their report the Commissioners deal with the present means of official control over purity of food, more especially in relation to arsenic, and discuss the general question as to what improvements are, in their opinion, needed in the official control over the purity of food.

As this is, perhaps, the most generally important outcome of their deliberations, and bears directly upon the question of the efficacy of the machinery which supervises the working of the Food and Drugs Acts, we propose to reserve the consideration of their recommendations to a subsequent article.

STATE AID FOR AGRICULTURE.[1]

MR. T. S. DYMOND, who has charge of the agricultural education in the county of Essex, has published a valuable little pamphlet on the State aid given to agriculture in Denmark and Hungary, two countries with which he is personally familiar. Both countries can show great gains to the farming industry during the past ten or twenty years, mainly the result of improved education and organisation, but they present an interesting contrast in the way the work has been done. In Denmark the initiative has come from the individual; the State has simply stepped in and assisted whatever institutions for education and research had been started by the people themselves. It is true the Government has founded and liberally endowed the Royal Agricultural and Veterinary College at Copenhagen, and also maintains the higher research stations, but to the cooperative societies and other commercial developments, which have done so much for Danish agriculture, it gives little or no direct help.

In Hungary the conditions are very different; the whole organisation has been created from above; not only has the State founded an extraordinarily complete department for education and research, but it has not hesitated to enter boldly into business and provide financial assistance to the farmers in distressed districts. It develops horse and cattle breeding by the help of great State farms, it has created a flourishing fruit industry, founded credit banks and cooperative societies, and generally adopted the "paternal" standpoint of fostering the farming interests wherever its assistance could be effective. Despite the great success of its efforts, Mr. Dymond considers that there are not wanting signs of State aid having gone too far in Hungary and having become State interference, resulting in a certain measure of discouragement to the enterprise of individuals.

Turning to our own country in the light of these examples, Mr. Dymond would limit the assistance of the State to education and research; the whole genius of the English farmer is opposed to State aid in his business matters. As Mr. Dymond points out, many parts of the country already possess considerable, if but slightly appreciated, facilities for agricultural education; farmers can get their sons educated at very low rates, their manures analysed, their seeds tested, they can obtain expert advice of all kinds as cheaply as in any foreign country. Only if you cross the county boundary none of these good things may be available, and an immense waste is going on through the want of system and the localisation in particular counties of the work that is being done.

Mr. Dymond argues for more central direction, and urges that the Board of Agriculture, which financially assists so much of the work, should assume a certain measure of control and bring the whole country into line.

Appositely enough, on the heels of Mr. Dymond's pamphlet comes the annual report of the Board of Agriculture on the distribution of grants for education and research in 1902–03. From this we learn that the Board gives substantial financial aid, 800*l*. a year with an extra 200*l*. for the maintenance of a farm, to seven colleges of university standing in England and Wales, and also grants smaller sums to eight other schools or colleges, the total expenditure amounting to 8900*l*. per annum. This, however, represents only a portion of the whole expenditure on these institutions; so far as can be made out from the report, the county councils concerned contributed 29,127*l*., which does not in all cases include capital expenditure and outlay on the farm. The total expenditure of all the county councils in England and Wales on agricultural education amounted to 87,732*l*. in 1901–02, and if we consider the distribution of this money, the manner in which comparatively minor matters, like poultry and bee-keeping and manual processes, bulk in the account, a very strong case is made out for more central control, for at present the Board of Agriculture only *inspects* the expenditure of one-third of the whole sum.

The weak side of the Board's outlay is seen in the "special grants for experiment and research." The total allotted is 864*l*. 6*s*. 1*d*.; is this magnificent sum to be taken as an index of the official opinion of the importance of English agriculture or of the value of research? The distribution, too, is curious; 225*l*. is for repetitions of Dr. Somerville's interesting "manure and mutton" experiment, 84*l*. 6*s*. 1*d*. is for trials of maize growing, 50*l*. for experiments on wheat; the Somerset County Experimental Farm, with the astonishing proviso that care shall be taken to keep records in future, gets 100*l*., as does the "Aberdeen Agricultural Research Association." Rothamsted, which we were told in the *Times* last year is being starved for want of funds, gets just nothing at all. There seems a want of proportion somewhere.

[1] "Continental State-aid for Agriculture." By T. S. Dymond. (Chelmsford, 1903.)
"Annual Report on the Distribution of Grants for Agriculture and Research in the Year 1902–3." (London: The Board of Agriculture and Fisheries, 1903.)

ROBERT ETHERIDGE, F.R.S.

IN the death of Robert Etheridge geological science has lost a distinguished worker who was actively engaged for upwards of fifty years.

Born in Herefordshire on December 3, 1819, he settled in early years in Bristol, and was for some time employed in a business house.

His scientific career commenced in 1850, when he was appointed curator to the Museum of the Philosophical Society in that city. This post he held for seven years, during which period he made himself thoroughly acquainted with the local geology, extending his observations into the region beyond Gloucester and Cheltenham, and becoming an active member of the Cotteswold Naturalists' Field Club. Through the influence of Sir Roderick Murchison (who had in 1834 published an "Outline of the Geology of the Neighbourhood of Cheltenham") he was in 1857 appointed one of the palæontologists to the Geological Survey, working at first under J. W. Salter, and assisting Huxley at the Royal School of Mines by giving demonstrations in palæontology.

In 1859 he published his first work, entitled "Geology: its Relation and Bearing upon Mining," being the substance of three lectures which he had delivered before the Bristol Mining School.

During the earlier portion of his service on the Geological Survey, he was occupied chiefly in arranging and naming the Invertebrata of the Secondary and newer strata, and after Salter had retired the Palæozoic fossils also came directly under his charge. Later on, when Jukes questioned the age and relations of the Devonian formation, Etheridge received instructions to re-investigate its palæontology and stratigraphical divisions, and the results of this arduous and important task were published in 1867 in a memorable paper "On the Physical Structure of West Somerset and North Devon, and on the Palæontological Value of the Devonian Fossils."

The list of his published papers is not a long one, but he contributed articles on the Rhætic beds of Aust, Westbury-on-Severn, Watchet and Penarth, and on the dolomitic conglomerate of the Bristol area. His work on the Geological Survey was mainly in the lists of fossils which he prepared for numerous memoirs

from 1858 to 1881. In 1875 he revised and edited a third edition of John Phillips's "Geology of the Yorkshire Coast." For many years he devoted all his spare time to the preparation of a list of British fossils, stratigraphically and zoologically arranged. Of this great work the first volume, dealing with the Palæozoic species, was published in 1888. Two other volumes, on the Mesozoic and Cainozoic fossils, have remained in MS. In all more than 18,000 species were catalogued.

In 1881 Mr. Etheridge, greatly to the regret of his colleagues on the Geological Survey, was appointed assistant keeper in the geological department of the British Museum, and this post he held with much advantage to that institution for ten years, when he retired from the public service.

He was elected a fellow of the Royal Society in 1871. In 1880 the Murchison medal of the Geological Society was awarded to him, and in the same year he was elected president of that Society. The two addresses which he delivered at successive anniversary meetings of the Geological Society were voluminous papers on the analysis and distribution of the British Palæozoic and Jurassic fossils.

These essays, which were based on his great catalogue, formed a foundation for a subsequent elaborate book (published in 1885) on "Stratigraphical Geology and Palæontology." This work, ostensibly issued as part ii. of a second edition of John Phillips's "Manual of Geology, Theoretical and Practical," was almost wholly re-written and very much enlarged by Mr. Etheridge, so that very little of the original text remained. No less than 116 tables of organic remains were incorporated, and very full particulars were also given of the strata in various parts of the British islands.

The stratigraphical knowledge which Mr. Etheridge acquired in his early days at Bristol, and afterwards with the field officers on the Geological Survey, qualified him to give expert advice on economic questions relating to coal, water-supply, &c. In consequence his assistance was frequently sought by engineers and others. During recent years he was engaged as geological adviser to the promoters of the Dover coal-boring, and was occupied on matters connected with it until but a short time before his decease.

A man of untiring energy and vigour, he seemed personally never to grow older, and it was not until lately that he lost his upright bearing, but he never lost the cheery, kindly disposition which endeared him to all his friends and associates.

He died after a few days' illness, the result of a chill, on December 18, soon after he had completed his eighty-fourth year. A good portrait of him was inserted by Lady Prestwich in the "Life and Letters of Sir Joseph Prestwich."

H. B. W.

NOTES.

It is announced that the committee of the Parisian Press Association has decided upon the award of the prize of 100,000 francs placed at its disposal by M. Osiris. The committee has resolved to divide this sum between the two inventions which have in recent times most contributed to the honour of French science. The sum of 60,000 francs has been awarded to Mme. Curie for the continuation of her researches into radium, and 40,000 francs to M. Branly for his labours in connection with wireless telegraphy.

The sum of 30,000 francs has been placed at the disposal of Prof. d'Arsonval by the *Matin*, of Paris, in order to enable him to continue his researches in connection with the properties of radium.

Among the numerous special kinds of radiation recently discovered, not the least interesting are the *n*-rays of M. Blondlot. These rays, which were first discovered in the radiations from incandescent bodies, pass readily through aluminium, glass, black paper, and other substances, but are arrested by lead or by moistened paper. They were at first studied by means of their action upon small electric sparks, but a more convenient means of observing them is due to their action upon feebly illuminated phosphorescent bodies, the luminosity of which is increased when the Blondlot rays fall on them. In a more recent paper, M. Blondlot has found that bodies in a state of strain, such as tempered steel and unannealed glass, give off these rays spontaneously and continuously at the ordinary temperature, and in the current number of the *Comptes rendus* M. A. Charpentier shows that these rays are also emitted by the human body, especially by the muscles and nerves. He points out that this effect may prove to be of the greatest importance in the case of the nerves, as up to the present no external reactions of the nervous system have been observed, and a new field of studies in physiology and medicine is thus opened up.

Dr. Osann, of Berlin, has been appointed professor of mechanics at Clausthal, and Dr. Kippenberger and Dr. Georg Frerichs have been appointed professors of chemistry in the University of Bonn.

The Venetian Academy of Sciences, Letters and Arts, offers prizes of 3000 lire under the Querini-Stampaglia foundation for monographs on the following subjects:—The lakes of the Venetian district, treated from a physiographic and biological standpoint; the works of Manuzi as a critic of Greek and Latin literature; the origins of Venetian painting; and advances in the projective geometry of algebraic surfaces of two dimensions in space of *n* dimensions. Under the Cavalli foundation, a similar prize is offered for an essay on the effects of modern social and economic conditions, &c., on landlords and farmers, with especial reference to the Venetian provinces. Under the Balbi Valier foundation an award of the same amount is offered for advances in medicine or surgery for the period 1902–3, and under the Minich foundation a prize of 3000 lire is offered for embryological researches on the development of the larynx, the trachea, and the lungs in vertebrates and birds. The last day for sending in essays for the Stampaglia prize, on the Venetian lakes, and the Balbi Valier and Minich prizes is December 31, 1903; for the remaining prizes the essays are due at the end of subsequent years.

In the course of excavations on the Lulworth Castle Estate, in Dorset, a number of bronze relics have been found, and have been sent to the Dorset County Museum on temporary loan. The most important object is a bronze sword, $24\frac{1}{2}$ inches long, and, though broken, it is in a fine state of preservation. Other relics are a socket celt, a gold or heavily gilt bronze finger ring, a socket gouge, a hilt of a sword, an object which is believed to be one of the fittings of a car, supposed harness fittings, and a bronze crook.

The following telegram was received from Mr. W. S. Bruce, leader of the Scottish Antarctic Expedition, at the offices in Edinburgh on December 17:—"Buenos Ayres. *Scotia* Stanley. December 2. Refitting here. Hydrograph surveyed 4000 miles unexplored ocean; 70° 25′ south, 17 to 45 W.; 2700 fathoms trawled there; wintered Orkneys; detailed survey. Mossman and five men continue first-class meteorological, magnetical, biological station. Ramsay died August 6. All others robust; *Scotia* splendid.

Bruce." This is the first official information which has reached this country from the expedition. Mr. Allan Ramsay was the chief engineer.

It is reported by Reuter's Agency that a scientific expedition, organised by the anthropological section of the St. Louis Exhibition, is about to leave England for Central Africa under the direction of Mr. S. P. Verner. With reference to his journey, Mr. Verner is stated to have said that in order to get at the aboriginal life as little changed as possible by civilisation, it is desired to go out of the track of previous explorers and of all settlers. The base of operations will therefore be from the capital of Chief Ndombe, paramount chieftain of the Lunda tribes, at the head of navigation of the Kasai River, the largest southern tributary of the Congo, from which place an effort will be made to penetrate the interior.

A despatch from Taganrog on December 15 states that the Sea of Azov has receded to such an extent during the past five days that the bed of the sea is visible for a distance of several versts. Taganrog is at the head of a bay of the extensive lagoon known as the Sea of Azov, and the depth of water in the roadstead is greatly modified by west and east winds. High winds are reported to have raised clouds of sand which have covered the town, and these are probably responsible for the exceptionally shallow water described in the despatch.

Mr. R. I. Pocock has been elected to the post of superintendent of the Zoological Society's Gardens in succession to Mr. W. E. de Winton.

Captain Stanley Flower, who was in England for a short time during the summer, has returned to his post at the Zoological Gardens, Giza, Egypt. He writes that the three specimens of the curious "shoe-bill" or "whale-headed stork" (*Balaeniceps rex*) received from the White Nile in 1902 are still in good health and condition in the Giza gardens. No living example of this rare bird has reached England since the arrival of Mr. Petherick's original specimens in 1860.

Mr. W. Eagle Clarke, of the Museum of Science and Art at Edinburgh, a well-known authority on the migration of birds, passed a month during the migratory season in September and October last on board the lightship on the "Kentish Knock," which is situated in mid-sea off the mouth of the Thames, about twenty miles from land. Mr. Clarke has made a series of valuable observations on the various birds which passed by the lightship during this period, and has obtained many specimens which were killed by flying against the lantern. A full account of Mr. Clarke's experiences will be published in the next number of the *Ibis*.

It is understood that the authorities of the British Museum (Natural History) and the director of the Geological Survey of Egypt have agreed to the preparation of a joint report on the wonderful discoveries of fossil animals recently made in the Fayûm. Dr. Andrews will proceed to Egypt early next year to examine and catalogue the specimens in the Geological Museum at Cairo, but will not attempt to make further collections. A fine example of the skull of the horned Arsinoitherium (perhaps the most remarkable of all these discoveries) is now exhibited in the central hall of the Museum at South Kensington.

Among the contents of the second part of the Bergen Museum *Aarbog* for 1903 is a paper by Mr. H. Broch on the hydroid polyps collected during the cruises of the exploring vessel *Michael Sars* in the North Sea from 1900 to 1902. Several new forms are named and described.

Mr. Ralph S. Lillie has found (*Amer. Journ. of Physiology*, viii., No. 4) that isolated cells and cell-nuclei suspended in cane-sugar solution through which an electric current is passed migrate in some cases with the negative, in others with the positive, stream. The majority of such structures migrate with the negative stream, and this tendency is especially strong in free nuclei and structures consisting chiefly of nuclear matter. Cells with voluminous cytoplasm, on the other hand, tend to move with the positive stream.

The violets of Philadelphia afford to Mr. W. Stone the text for an article on racial variation in animals and plants, which appears in the October issue of the *Proceedings* of the Philadelphia Academy. In the course of this article the author directs attention to the growing practice among American zoologists of discarding the use of trinomials, and classing as a species every distinct animal form, no matter how slightly differentiated. This usage, it is urged, receives support from the methods of botanical classification. Where is all this splitting going to end? is the question which naturally arises in the minds of old-fashioned zoologists.

The December number of the *Popular Science Monthly* contains two articles on biological subjects, the one, by Prof. T. H. Morgan, dealing with recent theories in regard to the determination of sex, and the other, by Dr. D. S. Jordan, on the salmon and salmon-streams of Alaska. Dr. Jordan recognises five species of Pacific salmon of the genus Oncorhynchus from these rivers, as well as three kinds of trout (inclusive of the now well-known rainbow-trout), and two other species belonging to other genera. As regards the salmon-tinning industry, the rivers of Alaska may be divided into three groups, king-salmon, red salmon, and humpbacked salmon streams. Those of the first class are the most important, but even these are less valuable than the corresponding rivers of British Columbia, owing to the fact that, from the shorter run, the fishes are nearer the spawning season when they enter, a larger proportion of them having white flesh in June than is the case with their Columbian brethren in August.

"The Geology of Worcester, Massachusetts," by Messrs. J. H. Perry and B. K. Emerson, has been issued by the Worcester Natural History Society (Worcester, Mass., 1903). It is a well illustrated work descriptive of the rocks and fossils of the county, and is written for those who have no technical knowledge of the subject. The interest is mainly petrological and mineralogical.

We have received the general report on the operations of the Survey of India during 1901–2, prepared under the direction of Colonel Gore, Surveyor-General. Work has been carried on in the United Provinces, and also in the Shan States and Burma. The question of the condition of the existing topographic maps of the country has engaged serious attention, and it is admitted that more systematic arrangements must be made for their revision.

The State of Indiana has issued in one volume (1903) the twenty-sixth and twenty-seventh annual reports for 1901 and 1902 of the Department of Geology and Natural Resources. Among the papers included is an important essay on the mineral waters of Indiana, by Mr. W. S. Blatchley, State geologist. He gives the location and describes the character of the waters of more than eighty wells and springs. Mr. Robert Hessler follows with an account of

the medicinal properties and uses of the waters. Mr. Blatchley deals also with the gold and diamonds of the State. Gold is widely disseminated in the Glacial Drift, but the occurrence of diamonds, which have been found while panning gold, is only of scientific interest. Mr. G. H. Ashley writes on the Lower Carboniferous area of southern Indiana, and directs attention to the economic products of the rocks, which comprise materials for good building stone, for the manufacture of Portland cement, and glass sands. There are also articles on the Orthoptera and Mollusca, and reports on the petroleum industry.

At the present time, when the British Cotton-growing Association is fostering the experiments which are being made to grow cotton in various parts of British Africa and in some of the West Indian islands, an account by the principal of the School of Agriculture in Cairo of the impressions gained during a visit to the cotton-growing States in America is particularly opportune. From a consideration of the principal characters of different cottons, and of the exclusive position which is held by Egyptian and South Sea island cotton, the writer shows that it is a matter of considerable importance to improve the quality as far as possible by taking advantage of selection and hybridisation. Practical suggestions are made with regard to the cultivation on the subjects of soil, planting, maturation of the seed, and rotation of crops.

Dr. Dixon has added to his contributions towards the elucidation of the mode of ascent of water in tall trees by suggesting a transpiration model, which is described in the *Scientific Proceedings* of the Royal Dublin Society. Over the top of a thistle funnel are fixed two parchment diaphragms converted into semipermeable membranes by soaking first in gelatin and then in tannin. These are arranged so as to leave a small space in which sugar is placed before closing up. A continuous column of water is established from the membranes through the funnel and connections, to a supply of water below. The water enters the artificial cell, fills it, and finally water and sugar soak through the outer membrane. The vapour tension of the water below the lower membrane is greater than that of the liquid in the cell, and the latter is greater than the vapour tension of the liquid above the upper membrane, so that a flow of water takes place from the reservoir upwards.

The *Transvaal Agricultural Journal*, which is issued quarterly, and has now reached its fifth number, serves to show with how much energy the Agricultural Department of the new colony, under the direction of Mr. F. B. Smith, is attacking the many problems of farming in that country. A more difficult task cannot well be imagined; the disasters of the war, which has denuded the country of its stock, have been accompanied by repeated attacks of epizootic diseases of all kinds, to which new importations of cattle succumb at once; at the same time the greatest drought since 1862 has occurred, and even Kafir labour has been forced up to a price prohibitive to the farmer. The numbers of the *Journal* bear evidence of the diversity and virulence of the diseases of stock that prevail; fortunately they show also that the Agricultural Department is busy with investigations on the origin of the diseases and the best preventive measures against them. The most dreaded diseases seem to be "red water" and the more recently discovered "Rhodesian red water" or "African coast fever," both of which are propagated by ticks as an intermediate host, but though animals get immunised or "salted" against the former, the latter seems invariably fatal.

Messrs. Macmillan and Co., Ltd., have published part v. of "A School Geometry," by Messrs. H. S. Hall and F. H. Stevens. This section contains the substance of Euclid Book vi., with additional theorems and examples.

Messrs. Dawbarn and Ward, Ltd., have added to their series of useful little "Rural Handbooks" a volume by Mr. H. Francklin on incubating and rearing utility fowls. The principles on which incubators and rearers are constructed are explained, and the advantages of artificial as compared with natural incubation are made clear.

A copy of the sixth edition of Strasburger's "Lehrbuch der Botanik" has been received from the publisher, Herr Gustav Fischer, Jena. The work has been completely revised, and many sections have been altered in order to adapt them to the present state of knowledge, especially in connection with plant physiology and morphology.

We have received the year-book of meteorological observations at the station of the First Order belonging to the *Magdeburg Journal* for the year 1900. This is the twentieth volume of the series, and contains, in addition to observations and results recorded in accordance with the international scheme, complete hourly readings and means, observations of earth temperature, evaporation, &c. As regards tabular statements of the results of a well equipped observatory, nothing better could be desired. The autographic registrations of a Campbell-Stokes sunshine recorder have been photochemically reproduced; the cards ranged side by side have a very neat appearance, and give a clear view of the amount of bright sunshine in the different months. During the seven months of April to October there were only thirteen sunless days.

The Christmas number of *Photography* (London: Iliffe and Sons, Ltd., price 1s.) is a production which will be heartily welcomed by those interested in the artistic side of photography. No pains seem to have been spared to render the book high class in every respect, and the thirty or more full-page and smaller half-tone reproductions from photographs printed on glazed art paper, and the letterpress and line drawings on rough antique paper, are sufficient proof of this statement. The contents of the letterpress consist of six articles on topics of widely different interest. Mr. F. H. Evans, on "The Characteristic Use of the Hands in Portraiture," gives some valuable hints on the conspicuous part played by the hands of sitters, and illustrates his remarks by photographs taken by himself. "Landscape in Pictorial Photography" is contributed by "Fecit," who in this delightful essay uses numerous illustrations of prominent photographers to elucidate his points. Other articles are "Photography in a Wood," by Mr. Will. A. Cadley; "W. Rawlings—a Photographer of Winter," by Monochrome; and, in a lighter vein, the "Walrus" gives an account of the weird inventions of "My Friend Choggles," and "Pettifer" prattles about his experiences of winter photography.

The report of the ninth meeting of the Australasian Association for the Advancement of Science, held at Hobart, Tasmania, in 1902, has now been published. The volume is edited by Mr. Alex. Morton, the secretary of the Royal Society of Tasmania, and runs to nearly nine hundred pages. The contents of the report, including as they do detailed accounts of the ten sections into which for working purposes the Association is divided, and reports of eight research committees, show conclusively that the Australasian men of science are following very successfully the example set by the parent association. The presi-

dential address for 1902, by Captain F. W. Hutton, F.R.S., dealt with evolution and its teaching. We have also received a copy of the Walker memorial volume published by the Royal Society of Tasmania, and containing the papers on early Tasmania read before the Society during the years 1888–1899 by the late Mr. J. B. Walker, vice-chancellor of the Tasmanian University.

The report of the U.S. National Museum for the year ending June 30, 1901, has just reached us from the Smithsonian Institution. Part i. of the volume (of 452 pages) contains the report of the assistant secretary and the reports of three head curators, a list of accessions to the museum, and a bibliography of the publications of the museum. The second part will, however, prove of more general interest, consisting as it does of five lavishly illustrated articles. These contributions are, first, a report describing the exhibit of the U.S. National Museum at the Pan-American Exposition at Buffalo in 1901, by Messrs. F. W. True, W. H. Holmes, and G. P. Merrill. This report is illustrated by seventy-two full-page plates, which it would be difficult to improve. Mr. W. H. Holmes also describes the flint implements and fossil remains from a sulphur spring at Afton, Indian Territory, this article being accompanied by twenty-six plates; and the same author deals with the classification and arrangement of the exhibits of an anthropological museum. Mr. Walter Hough discusses archæological field work in N.E. Arizona, and gives an account of the Museum-Gates Expedition in 1901, and with this monograph there are 101 plates, some of which are beautifully coloured. The last contribution is by Mr. J. B. Steere, and is a narrative of a visit to Indian tribes of the Purus river, Brazil.

A quantitative study by Dr. Paul von Schroeder (described in the *Zeitschrift für physikalische Chemie*) of the setting and swelling of gelatin has led to some interesting observations, which not only throw light on the phenomena of gelatinisation, but also form an important addition to our knowledge of reversible chemical changes. It appears that gelatin solutions undergo two types of change, a non-reversible hydrolysis by which the setting power of the solution is permanently impaired, and a reversible change as the result of which the jelly melts when heated and slowly solidifies when cooled. The setting power of a solution is accurately indicated by its viscosity. If after rapidly cooling from 100° the viscosity is measured at 25°, a low value is obtained which gradually increases until, if the decomposition of the gelatin has not proceeded too far, it culminates in the setting of the whole mass. By measuring the increment of viscosity during one hour it is possible to predict whether the solution will set in the course of the next twenty-four hours. The reverse process by which the gelatin swells and then dissolves in water presents similar points of interest. Gelatin saturated with water has a higher vapour-pressure than water itself, and loses weight in a saturated atmosphere; the difference of vapour-pressure is, however, very minute, and may be compared with that which exists between drops of different sizes, and causes the larger drops of a fog to grow at the expense of the smaller particles.

At a meeting of the Institution of Civil Engineers on December 15 several aspects of the important question of water supply were discussed. Prof. J. Campbell Brown read a paper on deposits in pipes and other channels conveying potable water. Analyses were given of incrustations on iron pipes, showing that these incrustations were due to oxidation of the iron of the pipes, whether wide-spread or in nodules, and that they were not limited to acid waters, but were common to acid, alkaline, and neutral waters. Investigations were recorded showing that slimy deposits on the inner surface of pipes, &c., were produced by gelatinous and filamentous iron-organisms which grew and extracted iron from the water, and died at one end while they grew at the other. Solid rock particles were entangled in this slime, and binoxide of manganese was deposited by chemical action, and this also was entangled in the mass of the gelatinous iron-organisms. Messrs. Osbert Chadwick and Bertram Blount introduced the subject of the purification of water highly charged with vegetable matter, with special reference to the effect of aëration. They showed that the purification of tropical waters was very difficult; they had found that treatment with iron was efficacious, but the treatment must be more thorough than with ordinary water-supplies. The character of these waters charged with vegetable matters rendered the removal of the iron difficult. Systematic aëration, so as to ensure an abundant supply of oxygen, was requisite. An apparatus had been devised in which the water was caused to flow through perforated plates, emerging in streams of small diameter and exposing so large a surface per unit volume of liquid that rapid absorption of oxygen from the air was made certain.

The additions to the Zoological Society's Gardens during the past week include two Malabar Mynahs (*Poliopsar malabaricus*) from India, presented by Mr. A. F. Vine; two South Albemarle Tortoises (*Testudo vicina*) from the Albemarle Islands, presented by the Captain and Officers of H.M.S. *Amphion*; two Hybrid Parrakeets (between *Palaeornis eximius* and *Psephotus haematonotus*), four Limbless Lizards (*Pygopus lepidopus*) from Australia, deposited.

OUR ASTRONOMICAL COLUMN.

Radial Velocities of β Aurigæ.—M. G. A. Tikhoff, of the Pulkowa Observatory, has recently concluded a research on the relative velocities of the spectroscopic binary β Aurigæ, and publishes his results in No. 3916 of the *Astronomische Nachrichten*.

The forty-one plates on which the results are based were obtained by M. Belopolsky, nineteen during the early part of 1902 with a Rutherford spectroscope, and twenty-two at the end of 1902 and the beginning of 1903 with a new Töpfer three-prism spectrograph. The relative velocities of the components are given in a table, which also shows the exact time at which the plates were taken and the interval since the last conjunction, and they show a maximum of 228 km. per second, on March 24, 1902, to zero.

The curve obtained on plotting these results gave 3d. 23h. 30·4m. as the period, and it also indicates that the system is not only a binary one, as announced by Prof. Pickering in 1890, but is made up of more than two bodies. This is confirmed by the spectrogram obtained on January 21, 1903, in which the line Hγ is made up of four components, indicating the existence of four separate bodies with different velocities.

M. Tikhoff has arrived at the conclusion that the system is made up of two pairs, each pair consisting of a star giving strong lines and another giving weak lines, and each element making a complete revolution about the centre of gravity of its pair in 19·1 hours. The ratio of the masses of the two groups is near unity, and the proper motion of the whole system as deduced from the magnesium lines at λ 4481 and λ 4352 is −16 km. per second. The epoch of conjunction may be taken as February, 1903, 3d. 10h. (Pulkowa M.T.).

The "Doubling" of the Martian Canals.—In discussing the instrumentality of "contrast" in producing the duplicated appearance of Martian canals, M. E. M.

Antoniadi directs attention to some experiments made by him which showed that when single, elliptical, dark spots were examined for a long unbroken period they appeared to develop a duplication similar to that observed in Martian phenomena. He also states that Schiaparelli repeatedly saw the well-defined dark seas with lighter interiors, and when the narrower seas, such as the Mare Cimmerium, Lacus Niliacus, and Sinus Sabæus were observed steadily for a long time, they manifested a tendency to beget islands which exactly resembled in shape the areas in which they appeared. M. Antoniadi directs attention to the fact that these islands always appeared to be surrounded by "dark canals," and he has therefore arrived at the conclusion that their appearance, and the apparent "gemination" of the canals, are simply results of the physiological effects of "contrast" (*Astronomische Nachrichten*, No. 3916).

OBSERVATIONS OF LEONIDS AND BIELIDS AT ATHENS.—In a communication to the Paris Academy of Sciences, M. Eginitis, director of the Athens Observatory, records the following observations of the Leonid and Bielid showers made at Athens during November:—

Leonids.—November 14, 11h. 50m. to 18h. (Athens M.T.), twelve meteors, appearing to emanate from radiants situated at $\alpha=152°$, $\delta=+25°$, and $\alpha=156°$, $\delta=+20°$, were seen.

November 15, 9h. 50m. to 17h. 50m., 187 meteors were observed from the following radiants:—$\alpha=150°$, $\delta=+22°$; $\alpha=153°$, $\delta=+21°$; $\alpha=152°$, $\delta=+24°$.

November 16, thirty-three meteors observed, chiefly from a radiant situated at $\alpha=150°$, $\delta=+17°$.

This shower appeared to attain its maximum between 15h. and 16h. on November 15. The general colour of the meteors was red, their velocities moderately swift, and their mean brightness equivalent to the fourth magnitude.

Bielids.—A watch was kept for this shower on the evenings of November 22, 23 and 24, but no meteors were seen on November 22, possibly because the sky was very hazy.

From 7h. 46m. to 16h. on November 23, fourteen meteors were seen, chiefly emanating from a radiant situated at $\alpha=23°$, $\delta=+43°$. On November 24 eleven meteors were observed, and these indicated the existence of two radiants, one at $\alpha=26°$, $\delta=+46°$, and the other at $\alpha=26°$, $\delta=+43°$.

In general the Bielids were red in colour and equivalent in brightness to the fifth magnitude stars; they moved so swiftly that their very short paths were hardly visible (*Comptes rendus*, December 7).

THE HIGHER EDUCATION OF WOMEN.

THE adequate provision of secondary and higher education for English girls and women is to be regarded as one of the accomplishments of the latter half of the nineteenth century. In 1850, for instance, the popular idea here and elsewhere was that women were intellectually incapable of benefiting by higher instruction. To quote Dr. Leslie Waggener, of the University of Texas, "it was seriously questioned whether the 'female' mind could untangle the intricacies of pure mathematics, could appreciate the abstruse speculations of metaphysics, or could follow, step by step, the inductions of a scientific investigation." Fifty years' experience has, however, demonstrated the complete fallacy of this preconception. Speaking at the Cambridge University Extension summer meeting in 1900, Mrs. Henry Sidgwick, principal of Newnham College, said of higher education for women, "I do not think its desirability is any longer seriously doubted by anyone who has looked into the facts, and whose opinion on the question is worth considering." Similarly, President Eliot, of Harvard College, in an address in 1896, referring to the university over which he presides, remarked, "it is a quarter of a century since the college doors were opened to women. Since that time, where girls and boys have been educated together, it has become an historical fact that women have made rapid strides, and captured a greater number of honours in proportion to their number than men."

So complete a change of opinion on a subject of such importance as the suitable education of the larger half of the human race deserves attention, and the steps in the movement which has resulted in the recognition of the claims of women at most universities throughout the world, supply a profitable study for all students of educational problems. A comparison, too, of the present provision of university courses for women with their complete non-existence in 1850 should serve to cheer those men of science and others who are endeavouring to improve our national education in other directions. It is gratifying, in beginning a brief historical summary of the growth of the movement to provide secondary and higher education for women, to be able to state that among the first efforts in this direction were those made in England. The absence of public secondary schools for girls in this country, and the impossibility of obtaining really educated governesses, were the causes which led the late F. D. Maurice and others to work with the Governesses' Benevolent Institution to improve matters, and the labours of these pioneers led to the establishment, in 1848, of Queen's College, London, the original object of which institution was to train women teachers. In the following year Bedford College, London, was founded, and so successful has it been that it is now one of two colleges for women which are constituent colleges of the reconstructed University of London. A good start having been made, the movement grew and ere long flourished greatly in several localities. The North London Collegiate School for Girls was established by Miss Frances Buss in 1850, and the Ladies' College at Cheltenham in 1853. The thorough education of the daughters of middle-class families had become sufficiently general in 1863 to convince the University of Cambridge of the advisability of at least trying the experiment of admitting girls to the local examinations conducted by them in various centres throughout the country, and in 1865 girls were formally admitted. Then came the Schools Inquiry Commission of 1864, which, after sitting for three years, reported at the end of 1867. Ladies were called upon by the Commission to give evidence as to the provision for the secondary education of girls, and, to quote Mrs. Henry Sidgwick again, "The assistant commissioners, who had examined and reported on the condition of secondary education in various districts, gave a deplorable account of the insufficiency of the girls' schools, and of the immense difficulty of finding any adequately-educated female teachers for them." In 1872, the National Union, under the presidency of Princess Louise, was started to reform girls' education. This association soon established the Girls' Public Day Schools Company, and at present, this company alone, has 34 schools, about 7000 pupils, and about 600 teachers of different grades.

This cursory glance at the history of the attempts made to supply English girls with secondary education is necessary, because the need created by the establishment of these schools for highly qualified women teachers directed attention to the necessity for the provision of higher education at English colleges and universities, a need which had hitherto been completely ignored. The recognition of the claims of women to as much education as they desire has in England been brought about gradually, and it will be convenient to indicate the more important steps taken since the foundation of Queen's College, London, in 1848, and then to outline, as exactly as possible, the present state of things in other countries. It will simplify matters, too, to deal with different countries separately, and to take the universities of Great Britain and Ireland first, and in most detail.

GREAT BRITAIN AND IRELAND.

Special lectures for women were started in connection with the University of Cambridge in 1870. Girton College was incorporated at Cambridge in 1873, though it had been in existence at Hitchin since 1869, and from its inauguration had prepared its students for the examinations of Cambridge, where women were first informally examined for the previous examination in 1870, and for the tripos examination in 1872. Girton was "designed to hold in relation to girls' schools and home training a position analogous to that occupied by the universities towards the public schools for boys." In 1871, a house of residence for women attending university lectures was opened in Cambridge, and this institution became known, in 1875, as Newnham Hall, and was constituted a college in 1880. In the same year as Newnham College was incorporated, the uni-

versity appointed a syndicate to consider the question of conferring degrees on women, with the result that in 1881, though degrees were refused, formal admission for women to the previous and tripos examinations was granted. And up to the present time the privilege of receiving degrees is withheld, though women are admitted by courtesy to almost all lectures. A syndicate appointed in 1896 recommended that degrees be conferred by diploma without permitting admission to membership of the university, but the proposal was rejected by the Senate in 1897 by 1713 votes to 662. The concession of 1881 still regulates the admission of women to the examinations of the university. In order to be permitted to take the tripos examinations women must reside at Girton or Newnham, and admission to these colleges is only granted to students who have passed the previous or some other recognised examination. A class list of female students is published after the examinations, along with the list of members of the university; the method of arrangement is the same in both cases, and certificates are given to women stating the class or place in class attained in each examination.

At Oxford, lectures and classes were started for women in 1873, and examinations were instituted for them two years later. An association for encouraging the education of women was formed in 1878, and is still in active existence. Through the secretary of the association women are admitted to nearly all the lectures given in Oxford, and the council of the association registers all women students. These students are either in residence at Somerville College (founded 1879), Lady Margaret Hall (1879), St. Hugh's Hall (1886), St. Hilda's Hall (1893), or belong to the Society of Home Students, comprising students who reside in private families and are supervised by the council of the association. In 1884, honour moderations and final honour schools of mathematics, natural science, and modern history were opened to women, and from time to time admission to the examinations of other schools was granted, but it was not until 1894 that they were free to present themselves for examination in all the subjects in which men may take the B.A. degree. Women are not eligible for degrees. Congregation rejected a proposal, in 1896, to admit women to degrees or to grant them diplomas recording their success in the final schools examinations. An important difference between Oxford and Cambridge is that at the former, university women are admitted to the pass as well as to the honour schools, and for either examination; an outside student is equally eligible with those who have studied and resided at Oxford.

As regards the extent to which women avail themselves of the facilities offered by the Universities of Cambridge and Oxford for their higher education, it may be said that, during the session 1901–2, Girton and Newnham together had 292 students, while in 1902 there were at Oxford 228 registered women students. The whole number of women students who took honours in the various triposes at Cambridge from 1881, the year in which they were opened to women, to 1900 was 1036, and of these 180 took honours in natural science, the numbers in mathematics being 250 and in classics 227.

The University of London, which received its first charter in 1836, was the first English university to recognise the claims of women. In 1867 the university was granted a supplementary charter, under which it was enabled to offer certain special certificates to women. In 1880 women were admitted to all the degrees, honours, and prizes which were at the disposal of the university, and in 1882 women graduates were admitted as members of convocation.

The University of Durham, by a supplementary charter granted in 1895, opened all its degrees except those in theology to women. Women are admitted to university lectures on the same conditions as men, but to qualify for the degrees women must reside at Durham in the women's hostel provided by the university.

The University of Wales, which came into existence under the charter of 1893, admits women to its examinations and degrees, as members of the university, on the strictest equality with men, and women are equally eligible for any office created by the university. Much the same is true of the recently constituted universities, such as those of Birmingham and Liverpool, and at the university colleges throughout the country no distinction is made between the sexes.

So far as the Scottish universities are concerned, that is to say, the Universities of Aberdeen, Edinburgh, Glasgow, and St. Andrews, it is only necessary to say that the Universities (Scotland) Act, 1889, included a provision "to enable each university to admit women to graduation in one or more faculties, and to provide for their instruction." An ordinance to this effect was passed in 1892, with the result that women are in every case admitted to the degrees in arts, science and medicine, and at Aberdeen to the degrees in law. The university lectures are, as a rule, open to women, but in some cases separate instruction is provided for them.

Despite current rumours, there are at present in Ireland but two universities, Dublin University, or Trinity College, Dublin, and the Royal University. The admission of women has been approved by the council of Trinity College, and a recommendation was brought before the Senate on June 9 of this year and sanctioned by an overwhelming majority. In the case of the Royal University of Ireland, which, like the old University of London was, is purely an examining body, all degrees, honours, scholarships, and even junior fellowships are open to students of either sex, and candidates for medical degrees alone are required to pursue fixed courses of study at special colleges.

Before reviewing the regulations for the admission of women to continental universities, a digression, interesting at least to men of science, may be permitted. What is the character of the education given in schools for girls by the women who have had the advantages resulting from the concessions now described? What part does science take in the curricula of the schools administered by university women? It may at least be said that it is becoming increasingly understood that household management is a branch of applied science; cookery and laundry-work are, in some quarters at least, recognised as applications of chemistry to domestic needs; and hygiene and physiology are appreciated to some extent as the foundations upon which the arrangements for the health of the home should be based. But the adherence to these commonplace truths is still too much a matter of theory, and the present methods of teaching in girls' schools are based almost exclusively upon what has grown up in the schools for boys. Prof. Armstrong, at this year's meeting of the British Association, offered a strong protest in this connection. He said, "When I consider what my own children have done at school, what girls generally are doing, I am in despair—the training is so hopelessly unpractical, so academic, so narrow in its outlook. There is so little insight and originality displayed by women in diagnosing and providing for women's requirements; female educators are so obstinate and difficult to persuade, so limited in their conceptions." More recently that vigorous and brilliant author, Mrs. F. A. Steel, has written: "Read through, for instance, the Education Act—new or old does not matter, since any Education Act I have ever heard of errs with equal and intolerable ignorance—and see if the one great unalterable difference in physiological life between a boy and a girl is even considered. It is not. And yet it is, it must be perforce, a potent factor in the whole question of girls' education."

The fact is that as yet we have not had sufficient experience in the direction of girls' education to come definitely to final conclusions. Speaking comparatively, it is a new movement, and such warnings as those just quoted, useful though they are as hints that caution and a reconsideration of the special needs of girls are necessary, should not lead to violent changes which are likely to do more harm than good. Though many questions raised are as yet insoluble, one thing at least seems tolerably clear, and that is the desirability of the introduction into all schools for girls of instruction in the scientific method. The inculcation of habits of exact observation, of accurate measurement, and of the absolute necessity for deriving all conclusions from sufficient premises, habits which are most easily and satisfactorily formed by the study of suitable branches of science, will act as the most effective corrective to the feminine disposition to arrive at conclusions intuitively, and to assert that a thing is so because it is so.

It may be pointed out here that there seems, judging

from the statistics of popular examinations, a disposition, in selecting the branch of science which shall form the foundation of the scientific instruction in girls' schools, to be guided rather by æsthetic than by educational considerations. To take one instance, in the local examinations of the University of Cambridge in 1902, while in the preliminary grade 1776 boys presented themselves in various branches of physics and chemistry, there were only 175 girls offering these subjects; on the contrary, 481 girls offered botany as compared with 65 boys. The same thing was true in the junior and senior grades; in the former about 5000 boys took up various subjects of physics and chemistry as compared with 300 girls, and in the latter the numbers were:—boys, more than 1300, girls, just over 100; in botany, on the contrary, the number of junior girls was 754, junior boys 29, of senior girls 261, senior boys 14. It is not suggested that it is impossible to inculcate scientific methods by means of the study of botany, for Prof. Miall has shown the contrary quite conclusively, but a knowledge of current text-books and methods leads to the belief that, nowadays at least, the above contention is a just one.

The urgent need at present, and one which might well engage the earnest attention of men of science, is to formulate a scheme of scientific instruction for girls' schools which, while inculcating the fundamental principles of physics and chemistry, shall lead to an intelligent application of these principles to the practical requirements of the household, whether in the kitchen, in the nursery, or in the general sanitary arrangements. Though such a course might well form the basis of the science teaching, there is no reason why an intelligent acquaintance with animate nature should not also be made. Nor need the special requirements of those girls who will later, instead of devoting their energies to home-life elect to take up scientific or medical work, be neglected. Since, as the imposing list of women engaged in scientific work given in the "Englishwoman's Year-Book," and the growing number of women doctors (177 were registered in the British Medical Register in 1894) show, there is an increasing attraction for women in the study of science, due provision for specialisation in science should be made in those secondary schools where girls remain until nineteen.

THE CONTINENT OF EUROPE.

In dealing with the provisions made for the university education of women in the different European countries, it is a little difficult to present inclusive generalisations. The local conditions vary so widely, and the national peculiarities are so various, that the most satisfactory plan is to deal separately with those countries in connection with which materials are available. Moreover, it is difficult within the limits of a single article, to attempt to summarise the history of the attempts made to improve matters so far as the higher education of women is concerned, and in the main it will be necessary to limit attention to the present state of affairs.

In Austria, to take the countries in alphabetical order, a decree of 1897, revising one made by the Minister of Education in 1878 regulating the admission of women to the universities of that country, ordained that any woman more than eighteen years of age who is a native of Austria may be admitted as a hearer to the philosophical faculty of an Austrian university, provided she has passed the *Reifeprüfung* or equivalent examination. The order for the admission of individual women is in the hands of the dean of the faculty, but an appeal may be made from his decision to the Minister of Education. Women hearers are under the same regulations as men. In 1896, Austrian women who had studied medicine at a foreign university were placed on the same footing as their countrymen in obtaining Austrian degrees in medicine. It is interesting to note in this connection that the first Austrian woman who obtained the degree of doctor of medicine did so at Vienna in 1897.

Women have been admitted to the universities of Belgium on the same conditions as men since 1883, though it must be stated that the Free University of Louvain is an exception, and does not admit women. Since 1890 an increasing number of Belgian women have availed themselves of the opportunity of university education.

To the Danish universities women have been admitted under the same conditions as men since 1875, and may take examinations and degrees in all faculties except that of theology, in which there is a special examination for women.

In Finland, women who wish to enter the University of Helsingfors, the only university in the country, must obtain the special permission of the chancellor of the university. Notwithstanding this impediment, there were in 1900 more than 200 women studying in the university.

All the courses in all the faculties and schools of the French universities with the exception of the *cours fermés* and the practical work are public, and open free of charge to persons of either sex as hearers. Matriculated students alone may attend practical work and the *cours fermés*; and to matriculate both men and women candidates must present a *diplôme de l'enseignement secondaire.* Women may become candidates for degrees on the same conditions as men. *Attestations d'études supérieures* are given by some faculties to hearers who have attended the courses regularly. In the provincial universities no requirement is made as to sex, but in Paris the hearer, to obtain the certificate, must have taken a bachelor's or an equivalent degree. It must be noted that not quite all the medical courses are open to women. The number of women students registered in French universities at the beginning of 1898 was 871, of whom 469 were studying medicine and 80 different branches of science. In the previous session 72 university degrees were obtained by women, but only one was in the science faculty, though 15 others were successful licentiates in science.

The universities of Germany do not treat women in a uniform manner. The conditions under which women study vary in different centres. As a rule, women are admitted only as hearers to the lectures of the philosophical faculty, though some German universities have permitted attendance in the legal and medical faculties. In the winter session of 1898–9, 414 women were in attendance at the ten Prussian universities as against 117 in 1895–6. At Berlin, Freiburg, Göttingen, Heidelberg, and Tübingen, women have been granted the degree of doctor of philosophy (Ph.D.). Even when women are admitted to the philosophical faculty of the universities they are mostly there on sufferance; they have no rights, and do not count as students. As Dr. Isabel Maddison has said, "the whole question of the admission of women to the universities has given rise to much discussion in Germany, and is still far from being settled. Many Germans regard the higher education of women as undesirable, and there is a strong objection manifested by a large number of the professors and students alike to the admission of women to the universities . . . the seriousness of purpose and the ability of individual women who have studied in Germany have, it is believed, done much towards destroying the prejudice against women students in the minds of the professors under whom they have worked."

In Greece, the National University in Athens was opened to women in 1895. The other institutions in the country of university standing, such as the English School of Archæology, admit women to their lectures. In 1895, too, the philosophical and medical departments of the universities of Hungary were opened to women by the Minister of Education, but to enter the universities they have to fulfil exactly the same conditions as men.

In Italy, in the Netherlands, and in Norway, women may enter the universities on a footing of equality with men. In Italy two classes of women students are admitted, viz. regular students and hearers. In the Netherlands no distinction is made between men and women; the latter are allowed to matriculate and to take degrees. Since 1884 women have been admitted to the lectures and degrees of the University of Christiania, and where there is no special regulation which prevents them, women may also compete for the scholarships and prizes.

All Russian universities exclude women. Special classes are held at St. Petersburg for the higher instruction of women under the supervision of the Minister of Public Instruction.

Speaking generally, the universities of Spain, Sweden, and Switzerland are open to women students. The Spanish universities have been open in a general way to women since 1857, when the universities of the country were placed under the control of the General Director of Public Education, but

Spanish women have made little use of the facilities offered. In Sweden, women appear to be excluded from the theological faculties, but since a Royal decree of 1870 they have been able to take medical degrees, and from 1873 the legal and philosophical faculties have been open to them. The seven universities of Switzerland are, without exception, open to women; the conditions under which they study vary somewhat in different universities.

AMERICA.

All courses and degrees of Canadian universities are, as a rule, open to women on the same terms as men, though in some cases they study for medical degrees in separate medical schools. The colleges of the various universities do not generally possess boarding accommodation for the students, who reside in boarding houses approved by the college authorities.

It is impossible at the end of a general article to do more than give one or two salient facts in reference to the higher education of the women of the United States. The report for 1899 of the Commissioner of Education states: "The barriers to women's higher education seem effectually removed, and to-day eight-tenths of the colleges, universities, and professional schools of the United States are open to women. . . . . The obtaining of a collegiate education gives the women more ambition to enter a profession, or if they decide to marry, it is stated that—'The advanced education they have received has added to their natural endowments, wisdom, strength, patience, balance, and self-control . . . and that in addition to a wise discharge of their domestic duties, their homes have become centres of scientific or literary study or of philanthropy in the communities in which they live.'"

The number of women undergraduate and resident graduate students in the colleges of university standing in the United States in the year 1900–1 was very nearly 47,000, and of these about 21,500 studied in colleges side by side with men. During this year 5050 degrees were conferred on women, nearly half as many as were gained by men, viz. 11,463.

Such are, in the barest outline, the leading facts as to the attitude of the more important countries towards the higher education of their women. The reader who desires more detailed knowledge should refer to the following sources of information, upon which the writer has largely based his conclusions:—"Handbook of British, Continental and Canadian Universities, with Special Mention of the Courses Open to Women," "Supplement to ditto, for 1897," by Dr. Isabel Maddison (New York: the Macmillan Co.). "Educational Systems of Great Britain and Ireland," by Graham Balfour (Oxford: Clarendon Press). "Education in the Nineteenth Century," edited by Dr. R. D. Roberts (Cambridge: University Press). "Growth of Educational Ideals during the 19th Century," by Sara A. Burstall (*The School World*, 1902). "Englishwoman's Year-Book, 1903" (Black). "Annual Reports of the Department of the Interior," by the Commissioner of Education (Washington: Government Printing Office).

A. T. SIMMONS.

CAVE EXPLORATION IN IRELAND.[1]

THERE is little doubt that the visit, a few years back, of the enthusiastic M. Martel, whose "Irlande et Cavernes anglaises" forms such pleasant reading, did much to rouse new interest in Irish caves. Dr. Forsyth Major soon after examined the Irish fossil Mammalia in the Dublin Museum of Science and Art, where Dr. Scharff was at the same time summarising his researches on the origins of the European fauna; on this question the pre-Glacial and post-Glacial Pleistocene remains naturally throw a considerable light. Mr. R. J. Ussher, already distinguished by his published work on southern caves, was fortunately again willing to devote his time to exploration. Circumstances were thus favourable to the formation of a committee, which, aided by grants from the Royal Irish Academy and the British Association, has examined certain caves near Ballymote, in the county of Sligo, and is actively engaged on others near Edenvale, in Clare.

[1] "The Exploration of the Caves of Kesh, County Sligo, being the First Report of the Committee, consisting of Dr. R. F. Scharff (chairman), George Coffey, Prof. Grenville A. J. Cole, R. J. Ussher, and R. Lloyd Praeger (secretary), appointed to Explore Irish Caves" (*Trans.* Royal Irish Academy, vol. xxxii. sect. B, part iv.). Pp. 46 and 3 plates. (Dublin, 1903). Price 2*s*.

The present report is a well edited quarto paper, with several illustrations. Mr. George Coffey, keeper of the collection of Irish antiquities in the Dublin Museum, deals with the traces of human occupation, and, like most of the contributors, has personal knowledge of the caves. The geological section is greatly strengthened by the visit of Mr. G. W. Lamplugh to Keshcorran, and his association as joint-author in the report. Messrs. A. S. Kennard and B. B. Woodward describe the Mollusca, and are known as specialists in this comparatively unworked branch. Mr. E. T. Newton, F.R.S., has identified the remains of birds, while Prof. D. J. Cunningham, F.R.S., describes the scanty human bones. In work where wide deductions may be founded on a single fragmentary relic, this specialisation among the contributors cannot be too highly praised.

Mr. Ussher's general description provides an interesting introduction to the detailed essays. Messrs. Cole and Lamplugh then show that the caves depend for their form on the joint-planes in the massive limestone, and that they were excavated by solution in pre-Glacial times. Glacial detritus then became banked against the slope, and crept into the caves from their mouths. As the ice melted, characteristic mounds of similar material were deposited in the lowland below Keshcorran.

A good part of the deposit within the caves is derived from the solution of the limestone, and includes characteristic bipyramidal crystals of quartz. A spicular crystalline material, mingled with the calcareous tufa, affecting polarised light, and soluble in acids, has unfortunately so far eluded determination. The possibility of the discovery of pre-Glacial remains in such caves in Ireland is pointed out.

As Mr. Ussher indicates, in commenting on Mr. Newton's list of the bones of birds from the caves, the smew, the grey plover, and the little auk are now rare inland, even in winter; the discovery of their remains has therefore some bearing on the climate during their occupation of Keshcorran. Dr. Scharff, in his account of the mammals, identifies the Arctic lemming, not previously known in Ireland. The remains of horse, obtained, with one exception, from the upper stratum of the principal cave that was examined, show that "horse-flesh probably formed one of the principal articles of diet of the cave-men." The traces of the mountain or Irish hare, the true *Lepus timidus* of Linné, indicate a larger animal than that now prevalent in Ireland. Bear (*Ursus arctos*) is represented by a fine left ramus of a lower jaw and very numerous remains. The distribution of the bones of all these animals is easily realised from the small maps provided, on which those found in the upper stratum are indicated separately from those in the lower.

Mr. George Coffey considers that man's occupation of the caves does not date back to a very remote period. Charcoal is frequent in the upper layers, and its distribution, together with the objects found, suggests a brief occupation of the caves in Neolithic times, and a more prolonged settlement when bronze and iron were both common. This latter occupation seems to have been as recent as the eighth to the eleventh century of our era, and Mr. Coffey ingeniously pictures the bear as responsible for the general avoidance of the locality in earlier times.

Mr. R. Lloyd Praeger, now editor to the Royal Irish Academy, summarises the results, and his detailed plan and the illustrative plates are worthy of the body which has undertaken their publication.

G. A. J. C.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

PROF. A. G. BOURNE, F.R.S., professor of biology at the Presidency College, is to take up the duties of Director of Public Instruction, Madras.

MR. H. J. MACKINDER, lecturer in economic geography at the London School of Economics, has been appointed director of the School in succession to Prof. W. A. S. Hewins, who has resigned the post.

ANNOUNCEMENT is made that Sir J. S. Burdon-Sanderson, F.R.S., regius professor of medicine at Oxford, has placed his resignation of the professorship in the hands of the vice-chancellor of the university.

THE Mysore Durbar has, says the *Pioneer Mail*, established four scholarships of 40 rupees a month each to encourage the study of analytical chemistry in the laboratory of the agricultural department. The scholarships will be tenable for one year, and will be open to candidates who have taken the B.A. degree in physical or any other branch of natural science. Students awarded scholarships will have to give an undertaking to serve the State for one year if required to do so, or to refund the money in case they refuse to serve.

IN a recent address at the distribution of prizes to the students of the classes held under the Liverpool School of Science subcommittee, Sir Philip Magnus, referring to the progress made in the provision of technical education in this country during the last few years, said that in 1886 the number of students in technological classes registered by the City Guilds Institute was 7060, and during the past session, that number has increased to 38,638. Moreover, apart from the sum of more than 1,000,000*l.* which local authorities expended last year on technical instruction as defined by the Technical Instruction Act, the State contributed the sum of 605,143*l.*, as against a total of 107,583*l.* in the year 1886, whilst the total State contribution last year to education generally amounted to more than 9,000,000*l.*, as against little more than 3,000,000*l.* in 1886.

AN appeal is being issued by the Senate of the University of London for funds to build and endow an institute of medical sciences under the control of the university. A letter signed by the chancellor of the university, Lord Rosebery, the vice-chancellor, principal and others has been circulated urging the claims of such an institute. Owing to the great changes which have taken place in medical education of late years, due to the increasing attention given to the teaching of the scientific subjects, it has become impossible, the letter states, for each medical school, out of the income derived from the fees of students, to build, equip, and maintain the laboratories, fitted with costly apparatus, which are necessary for modern scientific teaching. The faculty of medicine, a body consisting of 350 recognised teachers of the university, has ascertained the views of the teachers of the medical schools, and has recommended the Senate to establish an institute for the teaching of physics, chemistry, biology, anatomy, and physiology.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Astronomical Society, December 11.—Prof. H. H. Turner, F.R.S., president, in the chair.—Dr. A. A. **Rambaut** read a paper on two drawings of the Mare Serenitatis by John Russell, R.A., which afforded some hitherto unpublished evidence with regard to the appearance of Linné in 1788. Dr. Rambaut showed photographs of the original drawings, on which Linné appeared as a white spot, and not as a crater.—Mr. **Saunder** showed and described a photograph of one of the earliest maps of the moon, made by Langrenus about 1645.—The **Astronomer Royal** showed photographs of Comet Borrelly 1903 and Comet Perrine 1902, and pointed out their great similarity in appearance.—The Astronomer Royal also gave an account of the observations of the recent shower of Leonid meteors on the morning of November 16.—Mr. **Denning's** paper on the same subject was also read. There was complete agreement among the observers as to the maximum being between 17h. 30m. and 18h.—Mr. J. C. W. **Herschel** read a paper on an examination of the relative star density on different parts of the plates forming the Harvard photographic star map, from which it appeared that the maximum density was at about 9° from the centre of the plate, after which it fell off very rapidly.—Mr. **Crommelin** presented his ephemerides for physical observations of Saturn, 1903–4, and gave the different values that had been found for the planet's rotation period.—The secretary read a paper by Prof. G. W. **Hough** on the rotation period of Saturn deduced from his observations of the white spot first observed by Prof. Barnard on June 15.—Mr. Maunder read a letter from Mr. Percival **Lowell**, in which the latter affirmed his conviction of the reality of the canals of Mars, and also of the markings on Venus.—Prof. **Turner** described his graphical method for determining the local or Greenwich time of sunset at different places within a given region, and Mr. Benson spoke of a somewhat similar method previously devised by him.—The secretary read a paper by Mr. P. H. **Cowell** on the semidiameter, parallactic inequality, and variation of the moon derived from the Greenwich meridian observations from 1847·0 to 1901·5.—Mr. H. C. **Plummer** described and illustrated his paper on oscillating satellites.

Zoological Society, December 1.—Dr. Henry Woodward, F.R.S., vice-president, in the chair.—Prof. E. Ray **Lankester**, F.R.S., exhibited and made remarks upon some specimens of Medusæ reported to come from the Victoria Nyanza. Prof. Lankester also exhibited some drawings showing the hair-whorls on the face of two specimens of the okapi.—Mr. F. E. **Beddard**, F.R.S., exhibited and made remarks upon a portion of the large intestine and the cæcum of a boa (*Boa constrictor*) which had died in the Society's Gardens. The walls of the intestine in the neighbourhood of the cæcum and of the cæcum itself were thickened and inflamed. The cæcum was filled with a hard mass consisting of small stones and a number of the snake's own teeth, the presence of which, it was thought, had given rise to the inflammation.—Mr. Beddard also exhibited, on behalf of Mr. G. A. Doubleday, a hairless specimen of the common rat (*Mus decumanus*) which agreed in its characters with a so-called variety (*Mus nudo-plicatus*) of the common mouse figured in the Society's *Proceedings* (1856, p. 38, mamm. pl. xli.).—Dr. Walter **Kidd** exhibited a drawing of an *Oryx beisa* showing a reversed area of hair along the median line of the back, a character which was found only in ruminants, but not in all of them.—Mr. Oldfield **Thomas** exhibited an example of the naked rodent which he had in 1885 described as *Heterocephalus phillipsi*, but now thought should form a special genus, proposed to be called Fornamia, as its possession of only two cheek-teeth proved to be constant. The specimen had been presented to the British Museum by Dr. A. G. W. Bowen, R.N. A second species of Heterocephalus, distinguished by its smaller size and much smaller teeth, was described from British East Africa and named *H. ansorgei*.—Mr. G. A. **Boulenger**, F.R.S., exhibited a young hybrid newt (*Molge marmorata* ♂ × *M. cristata* ♀) obtained by Dr. Wolterstorff, of Magdeburg, in his aquarium, as reported in the *Zoologischer Anzeiger*, September 21. This specimen agrees in all external characters with *M. blasii*, de l'Isle, of which one of the original specimens, from near Nantes, S. Brittany, forming part of M. Lataste's collection, was also exhibited.—Mr. F. E. **Beddard**, F.R.S., read a paper on the tongue and windpipe of the American vultures, and remarked upon the inter-relations of the genera Sarcorhamphus, Gypagus, and Cathartes.—A communication from Miss Dorothy M. A. **Bate** contained an account of the species of mammals—fifteen in number—hitherto recorded from Cyprus. One subspecies—*Crocidura russula cypria*—was described as new to science.—The secretary, on behalf of Dr. R. N. **Salaman**, read a report on the *post-mortem* examination of the polar bear which had recently died in the Gardens. It stated that death was undoubtedly due to an aneurism of the aorta, which was possibly caused by a sharp bone at some previous time penetrating the œsophageal wall and lacerating the aortic wall.—A communication from Sir Charles **Eliot**, K.C.M.G., contained an account of thirty species of cryptobranchiate molluscs of the family Dorididæ from the east coast of Africa and Zanzibar. Of these eighteen were described as new.—A communication from Dr. A. G. **Butler** contained evidence in proof of the fact that the cardinal finch known as *Paroaria cervicalis* was only an immature condition of *P. capitata*.—Dr. P. Chalmers **Mitchell** read a paper on the occasional transformation of Meckel's diverticulum in birds into a gland.

Geological Society, December 2.—Sir Archibald Geikie, F.R.S., vice-president, in the chair.—Notes on the garnet-bearing and associated rocks of the Borrowdale volcanic series, by the late Mr. Edward E. **Walker.** A detailed description of sills and dykes of garnet-bearing rocks in the Langstrath Valley is given, and similar rocks are described, occurring as dykes and sills around the Eskdale granite and the Buttermere granophyre, and also in the Armboth-Helvellyn area. They consist of diabase, porphyrite, and granophyre. The rocks appear to be related to the Eskdale and Buttermere masses of intrusive rocks. Garnets are also found in a group of rocks below the great banded ashes and breccias of the Scawfell group, and in the rocks of the Scawfell group itself. These rocks often have a streaky structure, which exhibits types resulting from infiltration along planes of weakness, lamination of ash, flow of igneous material, and dynamic action on included fragments. The banded ashes of the Scawfell group also contain garnets. The garnets are of the almandine type. They often have a ring of felspar around them, which, when the intrusive rocks are studied, suggests that the mineral is original; but similar rings occur around garnets in the ashes, showing that the felspars may be formed in solid rock.—A contribution to the Glacial geology of Tasmania, by Prof. J. W. **Gregory,** F.R.S. After giving an analysis of previous contributions to this subject, the author describes the evidence obtained by himself personally in the northern portion of the island. The town of Gormanston stands on a Glacial moraine of recent geological age, formed later than the excavation of the Linda Valley, and occurring as a bank projecting from the southern side of the valley. The moraine is composed of typical Boulder-clay, and behind it are bedded clays, probably accumulated in a glacier lake above the moraine dam. An erratic of fossiliferous limestone, scratched all over and partly polished, is mentioned, while a railway has cut through an enormous boulder of black Carboniferous Limestone 16 feet in length. The northern face of Mt. Owen appears to be ice-worn to the height of about 1900 feet, while the base of the Glacial deposits is not more than 700 feet above the sea. The general evidence suggests that the Eldon Range and the central plateau formed the gathering-ground of the ice which flowed westward and south-westward. A map is given to show the range of Pleistocene glaciation so far as it has been recorded, and also to indicate localities of the glacial deposition, which probably dates from the Carboniferous period. The lowest level at which evidence of Pleistocene glaciation has been found is 400 feet on the Pieman River. Many of the deposits are little more altered than those of northern England, despite the heavy rainfall, and the aspect of some of the rock-scoring is very recent.

Entomological Society, December 2.—Prof. E. B. Poulton, F.R.S., president, in the chair.—Mr. G. T. Porritt exhibited, on behalf of Mr. T. Ashton **Lofthouse,** a specimen of *Xylophasia zollikoferi* taken at Sugar, near Middlesbrough, Yorkshire, on September 26 last. He said he believed that this was only the second specimen which had been recorded as having been taken in Britain. Mr. McLachlan, F.R.S., said the strongest evidence existed that a very large immigration of insects from the nearest Continental coast took place during the exceptional (for this year) spell of warm and calm weather prevailing towards the end of September, and he was of opinion that the specimen of *Xylophasia zollikoferi*, taken by Mr. Lofthouse in Yorkshire, formed an item in this migratory swarm. Mr. Eagle Clarke had witnessed such immigration when staying on board the "Kentish Knock" lightship for the purpose of studying bird-migration. He had witnessed a considerable immigration of *Vanessa cardui*, for instance, amongst many other insects, and not the least remarkable of his observations was the fact that *V. cardui* flies at night during migration as well as by day. Mr. McLachlan remarked that the laws governing migration in insects were at present little understood, and urged upon entomologists the necessity of obtaining a clearer insight into their working.—Mr. Malcolm **Burr** exhibited, and remarked on, a specimen of *Dinarchus dasypus*, Illig., belonging to a family of five or six species confined to the Balkans.—The president exhibited a series of photographs sent by Mr. A. H. **Thayer** to illustrate his views on the significance of the colours and patterns of butterflies' wings. The insects had been photographed on masses of foliage and flowers, and it was obvious that the dark ground-colour harmonised with the dark shadow behind and under the vegetation, while the light markings stood out as conventionalised representations of single flowers and flower-masses.—The president also exhibited the eyeless imagines and pupa-cases of *Ennomos autumnaria*, in illustration of his remarks at the meeting on November 18. Imagines produced by unblinded larvæ were also shown for comparison.—The Rev. Francis D. **Morice** read a paper entitled "Illustrations of the Male Terminal Segments and Armatures in Thirty-five Species of the Hymenopterous Genus Colletes."

Faraday Society, December 8.—Prof. A. K. Huntington presided.—The total and free energy of the lead accumulator, by Dr. **Lehfeldt.**—Bitumen in insulating compositions, part i., by Mr. J. A. **Sutherland.** Little or no trustworthy data have been published as to the use of bitumen for electrical purposes. The chief source of bitumen is Trinidad Lake, where there is estimated to be a quantity of nine million tons, which appears to be renewed to the extent of 20,000 tons annually. More than 150,000 tons are exported yearly. Bitumen is also found in Venezuela, California, and on the shores of the Dead Sea; it occurs in some limestone (asphalt) as an impregnation, about 10 to 15 per cent. being present, but it does not pay to extract it from this source. Its physical and chemical properties and constitution, which are fully dealt with in the paper, prove it to be infinitely superior to gas or coal tar for insulation and durability. The object of the present paper is to invite discussion and the views of electrical engineers to assist the author in the completion of his experiments, and to enable him to draw up a satisfactory definition of bitumen, so that users may secure the best results from its valuable non-hygroscopic and insulating qualities.

Royal Meteorological Society, December 16.—Capt. D. Wilson-Barker, president, in the chair.—Mr. W. **Marriott** gave some account of the meteorological work of the late Mr. James Glaisher, F.R.S. Mr. Glaisher was best known to the public for the twenty-eight balloon ascents which he made for scientific purposes in 1862–9 on behalf of the British Association committee. The highest ascent was that from Wolverhampton on September 5, 1862, when the height of about seven miles from the earth was reached. Mr. Glaisher was rendered insensible, while Mr. Coxwell's hands were frozen, and he was only able to open the valve of the balloon by tugging at the rope with his teeth.—A paper by Mr. J. R. **Sutton** on certain relationships between the diurnal curves of barometric pressure and vapour tension at Kenilworth (Kimberley), South Africa, in the absence of the author was read by the secretary.

PARIS.

Academy of Sciences, December 14.—M. Albert Gaudry in the chair.—The principal characters of band and line spectra, by M. H. **Deslandres.** The two classes of spectra have one important property in common, they are both formed by the repetition of similar groups of lines or bands, but there are numerous points of difference, the repetition of the groups being regulated by functions of different form in the two cases; line spectra are also affected by alteration of pressure and by an intense magnetic field, whilst band spectra are unaffected under similar conditions. The experiments made by the author, especially on the line and band spectra of nitrogen, are not in agreement with the usual view that line spectra correspond to the vibrations of the atoms, and band spectra to those of molecules. The views of Runge are also criticised, and the need of further experimental work pointed out.—Spectroscopical studies of the blood made on Mt. Blanc by the late M. Henocque, by M. J. **Janssen.**—The discovery of cones of Sequoia and of pine in the Portland strata in the neighbourhood of Boulogne-sur-Mer, by MM. R. **Zeiller** and P. **Fliche.**—On the suppression of magnetic hysteresis by an oscillating magnetic field, by M. P. **Duhem.** The author applies the theories previously developed by him to the experimental results of M. C. Maurain. M. Marconi has attributed the effects produced in his receiver to the suppression of magnetic viscosity, and M. Tissot to the suppression of

hysteresis; according to the author's theory it is the intervention of the viscosity which determines the suppression of the hysteresis.—The direct preparation of cyclohexanol and cyclohexanone starting from phenol, by MM. **Sabatier** and **Senderens**. The vapour of phenol mixed with hydrogen in excess and passed over reduced nickel at 215° to 230° C. gives a mixture of cyclohexanone and cyclohexanol. The vapour of this mixture, passed over reduced copper at 330° C., gives hexanone in a practically pure state; the same mixture, mixed with an excess of hydrogen and passed again over reduced nickel, gives the pure cyclohexanol. The method is general, and has been applied with success to the cresols.—On partial differential equations of the second order, by M. **Hadamard**.—On a generalisation of the theory of algebraical continued fractions, by M. E. **Goursat**.—On the differential equation of Riccati of the second order, by M. George **Wallenberg**.—A simple method permitting of the registration on the walls of a rotating cylinder of great pressures with small forces, by M. Albert **Hérisson**.—An internal combustion motor firing by compression, by M. **Cannevel**. In the motor described, the ignition is produced by a compression of about 30 atmospheres.—On a new method of measuring thicknesses and refractive indices, by MM. J. Macé **de Lépinay** and H. **Buisson**. The method consists in the observation of the rings of parallel plates and the fringes of mixed plates. The thickness of the plate is measured approximately to 0·01 mm., and the excess measured by the fringes, results having been obtained with plates up to 36 mm. thick. With plates of quartz of this thickness, the refractive index can be measured with an accuracy of some units in the seventh decimal place. Measurements on the same block of quartz, carried out on different portions of the plate, gave differences of four units in the sixth place, although the quartz was apparently perfectly homogeneous.—On the ionisation of phosphorus, by M. Eugène **Bloch**. Independent measurements of the mobilities, the coefficients of recombination, and of the ratio $\epsilon=\alpha/4\pi(K_1+K_2)$ for phosphorus ions lead to perfectly concordant results, the agreement giving the best demonstration of the real ionisation of phosphorus.—Study of a contact resistance, by M. A. **Blanc**. A contact resistance is of a very different nature from a metallic resistance, and is, under certain conditions, a reversible function of the intensity of the current. It undergoes an irreversible diminution whenever it is traversed by a sufficient current during an appreciable time, and this last phenomenon depends on the direction of the current.—On the distortion developed by shock in notched test-pieces, by M. A. **Pérot**. The effect of notching the test-piece is to limit to a narrow region the deformation produced, which is then recorded automatically by a photographic method. Diagrams are given showing the curves obtained with different specimens of the same metal.—Luminous sensation as a function of the time for coloured light. Discussion of the results, by MM. André **Broca** and D. **Sulzer**. A study of the retinal fatigue for different colours. Sources of light very rich in blue rays, such as the electric arc or very powerful incandescent burners, are injurious to the eye. The mean radiations of the spectrum, for which the energy is at a maximum, are those for which the human eye works most economically.—The emission of the n-rays (Blondlot rays) by the human organism, especially by the muscles and nerves, by M. Aug. **Charpentier** (see p. 182).—The action of a mixture of oxygen and hydrochloric acid on some metals, by M. Camille **Matignon**. Most of the metals of the platinum group are attacked by hydrochloric acid in the presence of air. Palladium and ruthenium are slowly attacked in the cold; iridium, rhodium and osmium at 150° C., the chloride being formed in all cases.—On the constitution and properties of the silicon steels, by M. Léon **Guillet**. Only steels containing less than 5 per cent. of silicon can be utilised; after tempering, these steels offer great resistance to shock, this power of resistance being relatively higher in high carbon steels. The results agree with those of M. Osmond in proving the existence of two solutions of silicon in iron, the one Fe—Si, the other $Fe—Fe_2Si$.—A new method for determining the critical points in iron and steel, by M. O. **Boudouard**. A modification of the self-recording method of Saladin, in which only one thermo-couple is required instead of two.—On meteoric irons, by MM. F. **Osmond** and G. **Cartaud**. Meteoric irons, on account of the extreme slowness of their cooling, show the normal state of equilibrium of the alloys of nickel and iron, whilst terrestrial alloys are in a metastable state.—On the preparation of the sesquiselenide of iridium, by MM. C. **Chabrié** and A. **Bouchonnet**. The selenide was prepared by the action of a stream of hydrogen selenide upon a solution of an iridium salt. It is amorphous, insoluble in nitric acid, and gave figures on analysis corresponding to Ir_2Se_3.—On the acetates of the alkaline earths, by M. Albert **Colson**. No acetochloride of calcium or magnesium, corresponding to the known barium salt, could be isolated.—The action of bromosuccinic and dibromosuccinic acids upon the pyridine and quinoline bases, by M. Louis **Dubreuil**. The action varies with the base and the solvent; by varying the experimental conditions malic, fumaric, bromofumaric, bromomaleic, and acetylenedicarboxylic acids can be isolated.—On a new tri-iodophenol, by M. P. **Brenans**.—Stereoisomerism in the esters of substituted camphocarbonic and methylhomocamphoric acids. Ethylcamphocarbonic acid, by M. J. **Minguin**.—Mercurammonium iodides of the primary and tertiary amines, by M. Maurice **François**.—On the esterification of phosphoric acid by glycerol, by M. P. **Carré**.—The origin of pearls, by M. Louis **Boutan**.—On the elementary factors of heredity, by M. Georges **Coutagne**.—On the geology and subterranean hydrology of the Eastern Caucasus, by MM. A. **Yermeloff** and E. A. **Martel**.—The supposed alcoholic fermentation of animal tissues, by M. F. **Batelli**. The results of the experiments described confirm those of Cohnheim, the alcoholic fermentation of the sugar obtained *in vitro* by extracts of the organs of higher animals being due to the presence of micro-organisms, and not to the action of an enzyme or of a nucleoproteid of animal origin.—Contribution to the study of amylo-coagulase, by M. A. **Boidin**.—Functional correlations between the poison glands and ovary in the common toad, by M. C. **Phisalix**.—The conditions special to the circulation of the glands in activity, by MM. G. **Moussu** and J. **Tissot**.

CONTENTS.

THURSDAY, DECEMBER 31, 1903.

SIR H. JOHNSTON'S BRITISH MAMMALS.

British Mammals; an Attempt to Describe and Illustrate the Mammalian Fauna of the British Islands from the Commencement of the Pleistocene Period to the Present Day. By Sir H. Johnston. Woburn Library. Pp. xvi+405; illustrated. (London: Hutchinson and Co., 1903.) Price 12s. 6d.

UNLIKE the birds, the mammals of our islands have not been "written out," and there was accordingly abundant room for a thoroughly up-to-date and trustworthy work on this section of the British fauna, which should record all that has been accomplished in connection with the subject during the last ten years or so, and especially with regard to local races, or subspecies, of well-known types. Whether the author has been successful in satisfactorily filling the gap that lay before him it is our purpose to inquire.

In the first place, it may be candidly admitted that in this handsome and strikingly illustrated addition to the "Woburn Library" the author has succeeded in producing an extremely interesting and attractive volume, as, indeed, from his well-known literary skill and experience it might have been confidently predicted that he would do. The selection of a writer of the type of Sir H. Johnston to undertake such an important and difficult task reflects, however, to a certain extent on the methods and ways of professed naturalists. Had one of the latter class been entrusted with the work, it is only too likely that he would have produced a volume of the dry-as-dust style, wanting in literary skill and picturesqueness, and therefore practically unreadable by the general public. All such danger has been avoided by the selection of such a famous amateur as Sir H. Johnston, whose work is in many respects well suited to the needs of a popular *clientèle*, although we think there is somewhat too much of such "blessed words" as "alisphenoid canals," "entepicondylar foramina," &c., the significance of which will scarcely be appreciated by the class of readers the author is likely to attract.

As regards the general character and scope of his work, Sir Harry Johnston has made British mammals a peg on which to hang a long and somewhat discursive account of mammals in general, and extinct ones in particular, and it must be confessed that on many occasions he gets decidedly far away from his proper subject. In this connection it may be noticed that, although Sir Harry alludes to his work as a compilation, from the absence of references to authorities (which is a conspicuous feature throughout the volume) it might easily be imagined by the uninitiated reader that many of the theories (often alluded to as though they were facts) were the author's own, a case in point being the presumed African origin of certain elements in the South American fauna.

For our own part, we confess that we do not like the plan of mixing up the later extinct forms with those still living, as it tends to confusion and to give an exaggerated idea of the extent of the British fauna, which is now essentially of an island type. This, however, is purely a matter of opinion, and the author has a perfect right to follow his own inclinations in this respect. Even here, however, he makes a serious blunder at starting. For in the table of "epochs," on p. 16, he includes the Pleistocene in the "Tertiary" instead of in the "Quaternary."

Although confessedly an amateur, and to a great extent, therefore, unacquainted with the *technique* and details of his subject, Sir H. Johnston has apparently such overweening confidence in his own abilities and knowledge that he has scorned specialist aid in the revision of his proofs, which are consequently disfigured by a host of blunders and omissions. That the study of British mammals has not been advanced by his labours is a mild way of putting the matter. It might be urged, indeed, that in a popular work this was not to be expected, and were it not for the ambitious and comprehensive style in which the task has been attempted, there might be some justification for this plea. As it is, there is none.

To justify this indictment, we proceed to quote a selection from the errors and omissions.

Firstly, as regards mammals in general, we notice on p. 19 that Platanistid dolphins are stated to occur only in the Amazon and Ganges. On p. 48 a vague theory of the use of the folds in the throat of the rorquals is alluded to in a foot-note, but no reference at all is made to the main use of these structures, namely, to form a dilatable pouch for the temporary reception of prey. On p. 84 we find the term *calcaneum* employed instead of *calcar* for the supporting style in a bat's flying membrane. Three pages earlier (p. 81) we find it confidently stated that bats never produce more than two young at a birth, whereas the occurrence of three or four in an American family was announced early in 1902 by Mr. Thomas, and later on in the same year by Mr. Lyon. On p. 135 the astounding suggestion is made that the British fossil panda (*Ælurus anglicus*) may have been more nearly allied to *Æluropus* than to the members of the genus in which it is placed. Apparently the author has no conception of the differences between the molar teeth of the two genera. On p. 166 it is stated that hyænas have only one pair of lower premolars, while, on the next page, the lower carnassial tooth of the spotted hyæna is said to be "reduced in size" as compared with that of the striped species, whereas precisely the reverse of this is the case. These are not all the instances of the author's lack of knowledge concerning mammalian dentition, for on p. 115 we find no reference to the opinion that the functional dentition of marsupials represents the milk series, or to a paper published a few years ago in the Zoological Society's *Proceedings* in which it was attempted to show that the number of premolars in the same group is four instead of three. We should also much like to know what authority there is for the statement (p. 353) that the Indian nilgai is the nearest living ally of the oxen. Even more astonishing is the assertion, on the next page, that the bisons take their origin from the Oriental bibovine group of cattle, as represented by the gaur and banting. Apparently the author is un-

acquainted with the fact that the conformation of the skull and the position of the horns are quite enough to refute this, apart from the circumstance that the "bibovines" exhibit a specialised, and the bisons the primitive, type of coloration. Again, on p. 351, we are told that the ewes of the European mûflon are invariably hornless.

Many remarks might be made with regard to the author's knowledge of extinct mammals, but perhaps it will suffice to indicate the extent of this by reference to a passage on p. 270, where we are calmly told that the Pliocene brachydont *Rhinoceros etruscus* is identical with the Pleistocene hypsodont *R. leptorhinus*! If this be not enough, we may refer to p. 291, where it is suggested that the extinct Sedgwick's deer may be allied to the Oriental rusine group. Evidently the author does not know the difference between a "brow-tined" and a "fork-tined" antler, as, indeed, may be gathered from certain statements in regard to supposed roe-antlers later on in the work.

Passing on to the modern British fauna, a few lines may be devoted, in the first place, to the author's nomenclature. We are glad to see that, in the case of the generic names of the bats, modern usage is followed. We also note that in this group the author follows the "*Scomber-scomber*" usage, thus calling one species *Myotis myotis*. This being so, we fail to see why the otter and the badger are not respectively termed *Lutra lutra* and *Meles meles*, in place of *Lutra vulgaris* and *Meles taxus*. It is well to be consistent even in nomenclature! Still more surprised are we to find the weasel designated *Putorius vulgaris* on p. 161 and *P. nivalis* in the illustration on p. 163.

In the notice of Bechstein's bat, the author states that Mr. Millais took a specimen in 1902, whereas he should have written 1901, and he seems unaware that in the former year a note was published in regard to a specimen taken in 1886. In treating of the smaller rodents, the author has totally ignored the work of modern specialists. For instance, in the case of the squirrel, there is no mention of the fact that the British animal is regarded by specialists as a distinct form, which should be known as *Sciurus leucurus* if ranked as a species, or as *S. vulgaris leucurus* if a subspecies. Again, although mention is made of its seasonal colour-changes, the important fact that there is a curious difference in regard to the shedding of the coat on the body and on the tail is left unrecorded. Full reference should have been made to the paper by Mr. Thomas on this subject. Worse remains to be told in the case of the mice. In describing the wood-mouse, the author records and names five local races. Evidently, therefore, he considers such races worthy of notice. On turning, however, to the common mouse, we find no mention of the Hebridean wild form described by Captain Barrett-Hamilton as *Mus muralis* in 1899, while there is an equal lack of reference to the local forms of the harvest-mouse named by the same writer in that and the following year, and consequently the omission of the full title of the British race, namely *M. minutus minimus*. Neither is there any reference to the fact that the British short-tailed field-vole should be known as *M. agrestis neglectus*, as pointed out by Captain Hamilton in 1896. Bearing in mind what has been said with regard to the local races of the wood-mouse, we can only attribute these omissions to ignorance on the part of the author—ignorance for which there is not the faintest shadow of an excuse in these days of up-to-date Zoological Records.

Other instances of this type might be quoted. We pass on to notice, however, that on p. 296 the author has actually reproduced figures of certain antlers from Scotland, published by Mr. Millais as those of the roebuck, although it has long since been shown that the specimens in question are antlers of the South American pampas-deer which by some means had got into Scotland. Not content with this, Sir Harry proceeds to argue that these "fork-tined" antlers approximate to the red deer type. Evidently his lack of knowledge of antlers is on a par with that shown in connection with zoological literature.

After so much fault-finding, we are glad to record that the author calls the ancient wild ox by its proper name of aurochs, although, here again, if he would but take the trouble to read the descriptive label in the Natural History Museum he would find that his views as to the relationship of the white park cattle (which he will persist in calling wild) are far from being up to the level of those who know anything about the subject, and are acquainted with the meaning of albinism.

Among the most attractive features of the work are the coloured plates, all of which have been reproduced from original water-colour sketches by the author himself, whose artistic taste and powers are well known. Unlike the pictures of animals which we are accustomed to see in zoological publications, these sketches are designed from a decidedly artistic standpoint, and are admirably suited to a work of this nature. Many of the illustrations in black and white are also by the author, and are, for the most part, both life-like and artistic. We should, however, like to know what authority there is for depicting the long-eared bat (p. 105) with the ears depressed, while the wings are extended.

In conclusion, we may say that, had the author contented himself with writing a book of a less pretentious style, and ignored anatomy and subspecies, we should have had less cause to find fault with his effort. As it is, a thoroughly accurate, complete, and up-to-date book on British mammals has yet to be written.

R. L.

THERMODYNAMICS.

Treatise on Thermodynamics. By Dr. Max Planck. Translated by Alexander Ogg, M.A. Pp. xii+272. (London: Longmans, Green and Co., 1903.) Price 7s. 6d. net.

THE important part played by thermodynamics in modern physics, and especially in chemistry, is a sure guarantee that an English translation of Prof. Planck's work will receive a warm welcome in this country. It deals with the first and second laws, changes of state, systems defined by any number of

variables, the phase law, gaseous systems, dissociation, and dilute solutions.

As is well known to specialists in thermodynamics, Prof. Planck, instead of using the thermodynamic potentials of the majority of writers, prefers to deduce the conditions of equilibrium from the study of the function

$$\frac{(\text{energy}) - (\text{temp.})(\text{entropy}) + (\text{pressure})(\text{vol.})}{-(\text{temperature})},$$

i.e. the ordinary thermodynamic potential corresponding to temperature and pressure as independent variables, divided by temperature and reversed in sign. While this function has not the advantage of being an exact analogue of the potential functions in statics, the differential coefficients of which with respect to the position-coordinates are equal to the corresponding generalised force-components, its introduction undoubtedly serves to bring the conditions of equilibrium and stability of thermodynamic systems into closer connection with the entropy properties. We should prefer to see the principle of degradation of energy instead of the entropy principle adopted as the basis of thermodynamics. This would obviate the introduction of Planck's function, the ordinary thermodynamic potentials taking its place. The compensating drawback is that the available energy of a system is not a definite measurable quantity, but is dependent on the surrounding media.

The method of introducing such notions as temperature and entropy cannot be regarded as satisfactory. We find in chapter i. the usual juggling with the terms "perfect gas" and "absolute temperature." Thus absolute temperature is defined in § 9 by the expansion of gases, while in § 24 these gases are shown to obey laws which are not rigorously consistent with this definition of temperature. The term "perfect gas" is introduced in a vague sort of way in this chapter, but without sufficiently definite statements being made as to what is a perfect gas and what is not. To define absolute temperature by means of a perfect gas and then define a perfect gas by means of its laws of expansion referred to absolute temperature is merely working round in a circle.

Moreover, the *entropy* of unit mass of a substance is defined, in the first instance, by the formula

$$\phi = c_v \log \theta + R/m \log v + \text{const.},$$

applicable to the case of a perfect gas. This definition is suggestive of the definitions of *pole* and *polar* given in many text-books, according to which "the line $xx' + yy' = c^2$ is called the polar of the point $x'y'$ with respect to the circle $x^2 + y^2 = c^2$." But while the effects of the latter definitions are made patent by the absurd answers sent up by a large proportion of examination candidates to pole and polar questions on (*e.g.*) a so-called "general conic," opportunities at present do not occur so frequently in this country of testing how an average student, after reading such a treatment, would "define entropy." To define a physical quantity in the first instance by means of its value in a particular case, when the definition is not valid in the more general case, is certain to be misleading, and no amount of subsequent discussion, such as Prof. Planck admittedly gives, can set matters right. We have marked instances of the same thing in the old-fashioned treatment of electrostatics and magnetism, in which bodies were stated without reservation to attract one another according to the law of the inverse square, and when dielectrics were subsequently introduced there seemed something wrong about the whole theory which the writer of this review never cleared up until after his undergraduate days.

From this it will be seen that if Prof. Planck's treatise is no worse than many others on the same subject, it is in some essential points no better. It is a book which will be read with great interest by the physicist, generally in conjunction with other books on the same subject, but it is scarcely the book for an engineer to refer to for information on the nature of "entropy." G. H. B.

GEOGRAPHY AS A SCIENCE.

The Teaching of Geography. By Prof. J. W. Gregory, D.Sc., F.R.S. (Melbourne and London: Whitcombe and Tombs, Ltd.)

The Austral Geographies. Classes ii., iii., iv., v. and vi. Same Author and Publishers.

PROF. J. W. GREGORY is taking an active part in the promotion of sound geographical instruction in the land of his adoption. In a lecture recently published he sets forth the scope of geography and the way in which it should be applied to education. In a series of school-books he shows practically how he would do this for Australian children.

For Prof. Gregory geography is not a science, but a branch of knowledge which may be taught scientifically—its subject-matter is "description drawn from observation; it is not a search for underlying principles, nor a discovery of ultimate causes." In applying this descriptive knowledge to education Prof. Gregory points out that descriptions must glide into explanations and awaken interests which cannot be satisfied without understanding this world of ours. The geographer must not hesitate to borrow from literature, history, or science that which will make his appeal to his pupil's imaginations most stimulating. Prof. Gregory's scheme, as developed in the "Austral Geographies," is to begin with a plan of table, school-room, school, &c., leading to a map, directions, seasons, clouds, rivers, land forms (in the first stage these are definitions), a brief description of Victoria, and a few lines about other Australian States and the continents. In each succeeding book some sections of physiography are discussed, and are followed by a description of (*a*) Australasia in Class iii., (*b*) the continents ending with Australia in Class iv., (*c*) the British Empire in Class v., (*d*) Europe, U.S.A., Japan, Pacific Archipelagoes, and world trade routes in Class vi. Both the physiographical and the geographical parts are so planned that each year more advanced conceptions, as well as greater details, are given. The books, in the hands of a good teacher who applies the hints given in Prof. Gregory's lecture, should yield useful results, and teach the pupil much about land forms and climate and descriptive topography.

The physiographical part is the better, but the limitations which Prof. Gregory applies to geography have hampered his treatment of the rest of the book. The land forms (a better term than earth forms) are accurately described, but although in his lecture he vigorously insists on "the fact of facts in geography is the circulation of water by its evaporation from the sea, its movement through the air, as invisible aqueous vapour, its concentration in clouds, and its fall as rain," he practically ignores climate in his descriptions of the different countries. He loses more than half the educational value through this neglect. Climate and configuration are equally indispensable fundamental factors in geography.

We agree with him when he protests against the idea that anthropology, zoology, botany, astronomy and geology are but branches of geography. This is not the geographer's point of view. The misconception is due to the confusion of the old South Kensington physiography—a useful introduction to elementary science, mainly physical, especially in its cosmical and terrestrial aspects—with geography. This physiography, as Prof. Gregory points out in his preface, gave a valuable training to many a teacher of geography, and helped to expel deep-rooted fallacies and misleading expressions which were (and to some extent still are) to be found in many geographical textbooks. We fear that Prof. Gregory believes that geography consists of two parts, a physiographical part which is scientific, and a topographical part which is purely descriptive.

We have no wish to undervalue the descriptive aspect of geography, but this does not involve a rejection of geography as a branch of science. Prof. Gregory, and those who think as he does, have not yet shaken off the effects of their own schoolboy experiences. They have not seen the world as composed of a number of very complex associations of rock, water, air, plant, and animal, including man, which may be classified generically and specifically as readily as the organisms which they contain. The aim of the geographer, like that of the botanist or zoologist, is not confined to observing and describing phenomena, but includes comparison, classification and interpretation. It is a science, a science of forms which have not hitherto been generally recognised as such, and the activities within and around them. The educational value of geography is as much in its scientific discipline as in its appeal to the imagination and sympathy. Prof Gregory's books fall short of the ideal in so far as he excludes scientific geography from his descriptive pages. He has not yet recognised these higher groupings of phenomena connected by a specific topography. We venture to think that the first part of the twentieth century will be as noted for the recognition and study of these macro-organisms as the latter part of the nineteenth century was for the recognition and study of micro-organisms, and we believe that the beneficial effect on the body politic will be as great in the one case as it has been in the case of the individual in the other.

A. J. Herbertson.

LIQUID FUEL.

Liquid Fuel and its Combustion. By W. H. Booth. Pp. xx+411. (Westminster: Archibald Constable and Co., Ltd., 1903.) Price 24s. net.

In view of the great interest taken at the present time in the subject of liquid fuel and the part it is likely to play in the future, Mr. Booth's book comes as a welcome record of the work done in the past, and would have been enormously enhanced in value had the references to the original papers been fully quoted.

The first part of the work deals with the general properties and advantages of liquid fuel, and a good deal of this portion of the book might with advantage be omitted in a future edition, as, for instance, the chapter on water, its properties and purification, which are certainly out of place in a book devoted to a special subject and not likely to be used as a manual for boiler practice.

Mr. Booth's ideas on the subject of combustion are open to criticism, as he is evidently a strong believer in the preferential combustion of the hydrogen in hydrocarbons being the cause of the liberation of carbon in the form of smoke and soot when there is insufficient air for complete combustion in the boiler furnace, but a consideration of the actions taking place in a water gas generator may shake his belief in this, as, if at such temperatures any preferential action exists, the fact that steam passed through red-hot carbon yields carbon monoxide, carbon dioxide, and hydrogen would certainly point to carbon and not hydrogen as the element most favoured by the attentions of the oxygen at the temperature of the furnace.

On p. 105 the author breaks into amusing diatribes against the man of science, and comes to the conclusion that "when the most important industrial operations are absolutely neglected by our supposed teachers and leaders of scientific practice, it devolves upon those to whom science is less familiar, but more attractive, to step into the breach." This sentence probably explains a good deal of the vagueness to be found in the author's speculations on liquid and gaseous carbon and solid hydrogen in the portion of the work devoted to calorific value and combustion.

In the second part of the book practical engineering questions are dealt with, such as oil storage, the atomising of oil for combustion, and the work which has been done with liquid fuel, both on the Continent and in America, and here the author is thoroughly at home.

The engineering side of the question is admirably handled, and the collection of data which is given will render this part of the work of exceptional value to those dealing with this important subject.

The chapters on compressed air, flue gas analysis, and calorimeters will be welcome to many practical men, and the appendix is of special value as containing a report of the United States Naval Bureau on tests of liquid fuel for naval purposes.

There is no question that the time has now been reached when the methods of burning liquid fuel are

sufficiently advanced to ensure a very considerable advantage over solid fuel, and that the great point that remains to be solved is the oil supply, which at the present time is so completely in the hands of big commercial combinations that any development of its use at once leads to an increase in price that renders its employment impossible. It must also be clearly borne in mind that the total oil production of the world is but a small fraction of that which would be needed if liquid fuel became universally adopted, and that of this quantity only a small proportion would be of the quality fitted for fuel purposes on board ship.

Mr. Booth's book is one which will be welcomed by all interested in this very important subject.

OUR BOOK SHELF.

Die "Seele" als elementarer Naturfaktor. Studien über die Bewegungen der Organismen. By Hans Driesch. Pp. vi + 97. (Leipzig: Wilhelm Engelmann; London: Williams and Norgate, 1903.) Price 1s. 9*d*.

The relation of soul to body is sometimes formulated as a "parallelism," sometimes as "interaction," and difference of theory depends, as a rule, on differences of standpoint. There is, however, another point of view in some ways more promising; it deals primarily with the organism as a whole, and posits the problem, "How must we conceive organisms which present the phenomena of purposive action?" The position is promising, because it appears free from the presuppositions involved in the direct question, How is mind related to body? but it really has an equally ambiguous element, because it involves placing on one scale forms of life which cannot be shown to possess the required continuous gradation. None the less, the method is interesting, and this book is an interesting example of it.

First, the author argues that mechanical explanations of life are inadequate; they fail to account for complicated readjustments; they fail, above all, to account for reactions which are not simple reflex movements, but imply choice and trial of means. The criticism establishing this deals with the older theories of reflex action, instinct, and the "Zentrum." This "Zentrum," in any sense in which it subserves merely mechanical combination, must be rejected; for it the author has to substitute some conception which admits of "free combination." This conception suffers rather from brevity of exposition, and is defined chiefly by negation; some points emerge clearly; the physical elements (nervo-cerebral system) are not themselves final, but an intermediary factor; there is over and above these the system of what the author calls psychoids, apparently gradated (Oberpsychoid, Unterpsychoid, &c.); the structural basis of, *e.g.*, association does not contain in itself the regularity required, but is a means to it. In addition to the mechanical factors, autonomous factors are asserted; the "outer factors" condition, but do not make experience; the gap which a physicochemical theory leaves is filled by the "Psychoid-Theorie" (p. 66).

The author does not err on the side of dogmatism; his exposition is interesting, and its relations to cognate psychological and metaphysical doctrines are carefully indicated; but is there any proof that "Bioautonomie" has only this explanation? and is the solution by means of the "Psychoid" (supposing we know exactly what that is) more than an old problem in a new form?

G. S. B.

Indians of the South-west. By George A. Dorsey, Ph.D. (Chicago: Passenger Department, Atchison, Topeka and Santa Fe Railway System.)

It is characteristic of American enterprise that the Passenger Department of the Atchison, Topeka and Santa Fe Railway System should issue a concise handbook on the Indians of the south-west by a distinguished field anthropologist. This most fascinating and important ethnological area has been investigated by many distinguished American ethnologists, whose results have appeared in various publications. The disjointed character of these memoirs, although they are often presented with a great thoroughness, has rendered it difficult for students, on this side of the Atlantic at least, to gain a clear conception of the various Indian groups, and of the significance of their complex rituals. The time is therefore ripe for a succinct presentation of the main facts already published concerning these peoples. Dr. G. A. Dorsey, of the Field Columbian Museum, Chicago, has travelled extensively in the south-west, and readers of Nature have frequently been informed of his valuable contributions to American ethnology. He is therefore eminently qualified to undertake the task, and in the 223 pages of this book he has condensed a vast amount of trustworthy information regarding the daily life, industries, and religious ceremonial of the natives.

The following subjects are dealt with:—the tribes, linguistic stocks and industries of the south-west peoples; the Pueblos of the Upper and Lower Rio Grande; the homes of the ancients; Zuñi and the seven cities of Cibola; domestic life of the Hopi; Flute, Antelope, Snake, and other ceremonies; ancient home of the Hopi; the Navaho, the Apache; tribes of the Yuman and Piman stock, and the tribes of south-eastern California. The book is illustrated with a profusion of beautiful and instructive illustrations, and a valuable bibliography is appended. Doubtless the publication of this book, of which 15,000 copies have been issued, will lead to the south-west becoming a popular resort for tourists.

This will rapidly hasten the Europeanising and vulgarising of the most picturesque and unspoilt of the existing pagan peoples of North America; indeed, traces of this decay are not already wanting. If this book succeeds in the purpose for which it was brought out, it will materially, though unintentionally, help to destroy the last surviving relic of advanced pre-Columbian culture in North America.

The Butterflies and Moths of Europe. By W. F. Kirby, F.L.S., &c. Pp. lii + 432. (London: Cassell and Co., Ltd., 1903.) Price 21*s*. net.

This book was originally published in 1882, and then comprised all the species that were included in the catalogue of Staudinger and Wocke (1871). The present volume brings the subject much more up to present knowledge, as it now contains descriptions of all the species of strictly European butterflies and larger moths enumerated in the great catalogue of Palæarctic Lepidoptera published by Staudinger and Rebel in 1901. The few species found in Madeira and the Canary Islands, but not met with on the Continent of Europe, have also been included, so that the work will afford an excellent help to any entomological Continental tourist, or those who perforce escape the rigour of our winter months in the Atlantic islands. Mr. Kirby has also brought our knowledge of the larvæ of these species up to date by the description of those discovered since the publication of his previous volume.

The author has achieved considerable success in the difficult task of writing a popular guide without pro-

ducing a non-scientific volume, which is embellished with fifty-four plates, fifty-three of which are coloured, and contains a full and useful introduction. With this, among the many other popular works on natural history recently published, we may look forward to a prospective time, when the general reading public, and lovers of animal life, will be sufficiently acquainted with the main aspects of general zoology as to enable them better to grasp the real import of the many conclusions and theories—philosophical and otherwise—which have followed the great Darwinian conception. It may also be hoped that the narrative of life-histories of insects, now so frequently detailed and so easily consulted, may incite a further cultivation of economic entomology, a subject in which our American cousins still hold the field.

Grandeurs Géométriques. By J. Pionchon. Pp. 128. (Paris: Gauthier-Villars, 1903.) Price 3.50 francs.

EXPERIENCE in the teaching of young engineers at Grenoble has induced Prof. Pionchon to undertake the task of publishing some seventy little volumes presenting in a clear outline the fundamental notions, theoretical and practical, which should form the basis for further study. The collection includes sections on mathematics, mechanics, physics, electricity, and economics, and the present volume is the fourth of the first section. It explains in an elementary way the nature of the different geometrical entities and the methods by which they are measured. There is no attempt to dip beneath the surface and introduce any of the philosophy of the subject, but some passages in smaller print give rather more advanced considerations and analytical formulæ without proof.

If the book stood alone it could perhaps be passed without comment, but the prospect of seventy others of the same kind compels a word of criticism. It must be admitted that the contents appear to be perfectly sound, but beyond this we have little praise to bestow. Whatever it contains of value ought to be in the notebook of every engineering student who has had the minimum necessary instruction in mathematics, and if it is not already there, the reading of this volume will only lead to that undesirable sort of knowledge which too often forms the main part of the mathematical equipment of engineers, and is unfortunately encouraged by some of their teachers. The appearance of the pages suggests that they are designed to compensate physical as well as intellectual myopia, and this emphasises the inanity of many of the propositions. The author must be singularly devoid of the sense of humour. R. W. H. T. H.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Secondary Radiation produced by Radium Rays.

I LATELY had occasion to produce some radium radiographs of two partially overlapping pennies contained in a paper envelope which was laid directly upon the photographic plate. A print from one of the results shows that the shadow of the upper coin is blurred and diminished where the rays pass through air from the edge of this coin to the plate, but that it is sharp and of the correct size where the rays pass to the plate through the lower coin. This seems to point to the production of a considerable secondary radiation by the rays in their passage through air. L. R. WILBERFORCE.

University of Liverpool, December 22.

An Interesting Yucca.

IT frequently happens that facts of much general interest are published in systematic monographs and other taxonomic works, and are in consequence overlooked by many of those to whom they would be most valuable. Turning over the pages of the revision of the Liliaceous group Yucceæ, published with superb illustrations in the 1902 report of the Missouri Botanical Garden, I came across some statements which seem to deserve wider circulation and comment. The whole of the work referred to, by Dr. Wm. Trelease, is exceptionally well worth reading on account of the extremely lucid presentation of the facts, but the statements which especially interested me are as follows:—

The subgenus Chænoyucca contains thirteen species, some of which have the style green while others have it white. *Yucca glauca* is the very common narrow-leaved green-styled species of Colorado and northern New Mexico, extending to South Dakota and central Kansas. The inflorescence is simple, or with an occasional branch. *Yucca constricta* is a white-styled species, very similar to *Y. glauca*, found from the Pecos River region of Texas to Seward County, Kansas, where it meets the range of *Y. glauca*. It has the inflorescence rather amply branched at the top. A few years ago Mr. James Gurney, head gardener of the Missouri Botanical Garden, "was struck with the variety of foliage and difference of vigour of growth" shown by the Yuccas of Seward County, Kansas, all being ostensibly *Y. glauca*. He collected a considerable number of these plants to show the differences, and they were transferred to the Missouri Garden, where some of them have bloomed. Among them was one which had practically the foliage of *Y. glauca*, but it produced "a rather ample long-pedunculate panicle of pure white flowers, with white styles," which began to expand at the end of the flowering period of *Y. glauca*. This specimen was by no means to be separated from *Y. constricta*. Other specimens exhibited the normal flowers of *Y. glauca*, and still others had flowers like those of *glauca*, but with a conspicuously branched inflorescence. This last form agrees with the long-lost *Yucca stricta* of Sims, but is placed by Dr. Trelease as a variety of *Y. glauca*. In addition to these differences in the flowers, the foliage varied in breadth and flexibility.

No suggestion is made by the author that the phenomena described are the result of hybridisation, but it is well known that Yuccas are frequently crossed in cultivation, and Dr. Trelease presents an extended discussion of Yucca hybridisation in another part of his paper. In the case of the Seward County plants, we have an unexpected and great mutability developing locally in an ordinarily stable species of wide distribution; and is it not suggestive, to say the least, that this should occur just where the ranges of *Y. glauca* and *Y. constricta* overlap, and that the so-called *stricta* should have more or less intermediate characters taken as a whole, while the features taken separately are nevertheless pure? May this not be a case conforming with the Mendelian laws? In any event, it seems well worth consideration, for the mutability has to be explained somehow or other, that is to say, there must be a reason for it.

Granting the supposed hybrid origin of *Y. stricta*, the case is curiously parallel to that of the perplexing woodpeckers of the genus Colaptes inhabiting the same region, which are intermediate between the eastern yellow-shafted and western red-shafted species.

The only other Yucca which could be involved in the above discussion is the green-styled *Yucca mollis* (*Y. angustifolia mollis*, Engelmann, 1873),[1] but this is not known to extend so far west as to meet the range of *Y. glauca*.

T. D. A. COCKERELL.

Colorado Springs, Colorado, U.S.A., December 13.

[1] Dr. Trelease names this *Y. arkansana*, "in deference to the prevalent American practice in nomenclature" whereby *mollis* is held untenable because of Carrière's prior *Y. gloriosa mollis*, applied to a garden form. A practice which permits a name proposed for a garden variety of a different species to stand in the way of an otherwise valid specific name should surely be condemned.

SOKOTRA.[1]

Although the island of Sokotra is often seen by passengers on the great ocean steamers which pass by the Sokotran Archipelago on their voyages to and from India, eastern Asia and Australia, the fauna had been very imperfectly investigated when, in 1898, a party was dispatched by the joint exertions of the British and Liverpool Museums for the purpose of collecting specimens of the animals, vertebrate and invertebrate. The botany of Sokotra itself had been previously studied by Prof. Bayley Balfour and by Dr. Schweinfurth in 1879–81, and some collections of the animals occurring had been made by them and by other visitors to the islands, but the zoology was still incompletely known.

The party of 1898 consisted of Dr. H. O. Forbes himself, Mr. W. R. Ogilvie Grant, of the British Museum, and a taxidermist. Native assistants and servants were engaged at Aden, and valuable aid was given by the Government of India, which supplied means of transport between Aden and the islands, and lent camp equipage for the use of the explorers.

The Sokotran Archipelago consists of (1) the large island of Sokotra, about eighty-five miles in length, lying 150 miles to the eastward of Cape Gardafui in Africa and about 230 miles S.E. of Ras Fartak in Arabia; (2) Abd-el-Kuri, a much smaller island, lying about half way between Sokotra and Cape Gardafui; and (3 and 4) two islets, Semha and Darsi or Darzi, known as the Brothers, between Abd-el-Kuri and Sokotra. The two larger islands are separated by a submarine valley, 100 fathoms deep, whilst a channel several hundreds of fathoms in depth intervenes between Abd-el-Kuri and Cape Gardafui, and the sea between the islands and the Arabian coast is still deeper.

Dr. Forbes's party landed and made collections on Abd-el-Kuri, and they spent about two months in the hilly region of eastern Sokotra, but were unable to visit the smaller islets. The expedition was much delayed, first by some trivial political difficulties with the Sultan of Sokotra, and secondly, and more seriously, by severe attacks of fever.

Simultaneously with Dr. Forbes's expedition, an Austrian scientific party which, under the direction of Count Lambert, was engaged in exploring the archæology, geology, and natural history of southern Arabia, visited the Sokotran Islands. This party was larger and better equipped than Dr. Forbes's modest expedition, it had a steam vessel, the *Gottfried*, at its disposal, and was able to visit the islet of Semha as well as Sokotra and Abd-el-Kuri. Amongst the members of the Austrian party were Prof. Müller, Dr. Kossmat the geologist, and Prof. Simony the naturalist. At a time when Dr. Forbes's party was suffering severely from fever, and had almost been brought to a standstill by illness, most valuable medical assistance was given to them by the Austrians.

The finely illustrated volume now published contains the results of the expedition, and owes its appearance to the Museums Committee of the Corporation of Liverpool, which has provided the funds, and authorised the publication of the work as a special bulletin of the Liverpool Museums. The book is edited by Dr. Forbes, and comprises a narrative of the journey from his pen, and descriptions by various naturalists of the different groups of animals, vertebrate and invertebrate, collected by the expedition. The list of authors is too long to quote in full, but it comprises, besides Dr. Forbes and Mr. Grant, several eminent zoologists, amongst whom are Mr. Boulenger, Mr. E. A. Smith, Mr. R. I. Pocock, Sir G. Hampson, and Mr. W. F. Kirby, of the British Museum staff, besides Colonel Godwin Austen, Mr.

Fig. 1.—Camp at Adho-Dimellus. (From "The Natural History of Sokotra.")

[1] "The Natural History of Sokotra and Abd-el-Kuri." Edited by Henry O. Forbes, LL.D., Director of the Liverpool Museums, &c. Pp. xlvii+598; 30 plates and numerous figures in the text. (Liverpool: The Free Public Museums; Hy. Young and Sons; London: R. H. Porter.)

McLachlan, Lord Walsingham, and several others. A complete list of the plants of Sokotra and Abd-el-Kuri, inclusive of important additions obtained by Dr. Forbes, is furnished by Prof. Bayley Balfour, whilst a note by Prof. J. W. Gregory on the geology is a reprint of a short paper published in the *Geological Magazine* for 1899. This paper, which was founded on a collection of rock specimens brought back by Dr. Forbes's expedition, is supplemented by an extract from a report by Prof. Bonney on a similar collection made by Prof. Bayley Balfour in 1880. It is very much to be regretted that a translation of some of Dr. Kossmat's published notes on the geology was not also added, for whilst, as might be expected in reports on rock specimens collected by naturalists who are not geologists, the notes now reprinted give a fair account of the crystalline and volcanic rocks of the Sokotran group, they afford a very imperfect idea of the sedimentary formations, although the latter occupy by far the greater portion of the islands. The massive Nummulitic, Alveolina, and Hippuritic limestones, of which the islands chiefly consist, and which are of much greater geological importance than the granitic formations underlying them, are only mentioned vaguely as Cretaceous and Eocene limestones. No notice naturally is taken of one curious discrepancy between the collected specimens and Dr. Kossmat's statements. Both Prof. Balfour's and Dr. Forbes's collections from Sokotra contained comparatively modern volcanic rocks resembling those of Aden, whilst Dr. Kossmat states that no such rocks occur in Sokotra. ("Jungvulcanische Bildungen fehlen auf Sokotra—ganz im gegensatze zur gegenüberliegenden Küste Arabiens—vollständing," Sitz. math. nat. Cl. K. Akad. Wiss. Wien, 1899, p. 77.) The absence of Prof. Gregory in Australia is probably the reason why a fuller account of the geology as now known is not supplied.

FIG. 2.—Dragon's-Blood Tree. (From "The Natural History of Sokotra.")

The work is well illustrated with coloured plates and figures in the text. Amongst the plates, the representations of the wild ass (introduced by man but now feral), of some of the birds (especially a new goatsucker, *Caprimulgus Jonesi*), and of the land mollusca, spiders and insects (butterflies, moths, microlepidoptera, wasps and bees, beetles, &c.), are good examples of chromolithography. The text figures of mollusca and beetles, each surrounded by a grey rectangular area in which the actual shell or insect does not always occupy the central position, though good representations, have a somewhat unpleasing effect. The few figures of plants are good, and especial attention may be directed to the remarkable Euphorbia discovered by Dr. Forbes in Abd-el-Kuri.

As is usually the case in books like that now before us, some curious illustrations of zoological nomenclature are conspicuous. For instance, Mr. Kirkaldy, to whom we are indebted for an account of the Rhynchota, has invented a generic name which he spells *Klinophilos*. Naturalists in general who follow the old rules of Latin orthography would have written *Clinophilus*, but orthographical heterodoxy is by no means the most extraordinary feature of the case, for the new name is given to a genus the type of which appears, according to the rules of Linnæus himself, to be also the type of the Linnæan genus Cimex.

Again, in the two sections dealing with the land mollusca, each of the two authors quotes a generic name, Achatinelloides, given, not by themselves, but by another writer. It is difficult to understand why so absurd a term as this, derived from a double Latin diminutive of dubious accuracy by the addition of a Greek adjectival termination, should be preserved instead of being simply ignored. Some explanation, too, might have been vouchsafed why the same families of mollusca are termed Pomatiidæ and Pupidæ by one author, Cyclostomidæ and Helicidæ by the other.

The discussion of the "distribution of land and water in the Indian Ocean as indicated by a study of the fauna and flora of the islands" is one of the subjects mentioned in the preface as having been left over for a future publication. It is to be regretted that a general summary of the results obtained, so as to afford an idea of the zoological relations between Sokotra and the neighbouring continents, has not been added to the present volume, and it must be hoped that Dr. Forbes, who has already contributed to our knowledge of the distribution of animal life in the islands of the Indian Ocean, will before long publish his views on the results of his investigation of the Sokotran fauna.

The principal features of Sokotran zoology are the following. There are, as already remarked, no indigenous mammals, no batrachians or freshwater fishes. Amongst sixty-seven species of birds recorded from Sokotra, eleven appear to be peculiar to the island, and of the twenty-two hirds from Abd-el-Kuri three are unknown elsewhere. Of twenty Sokotran land reptiles no less than fifteen are peculiar, and three genera out of thirteen; the number known from Abd-el-Kuri is only three, of which two are peculiar to the island, whilst one is rather widely dis-

tributed. The forty-eight species of land mollusca inhabiting Sokotra are all, so far as known, restricted to the island, and the same is the case with the nine species from Abd-el-Kuri, whilst it appears very doubtful whether the Cyclostomaceous genus Lithidion, common to the two islands, ranges beyond the Archipelago. In arachnids, myriopods and insects, a large proportion of the species are peculiar, though not always to the same extent. As regards the relationship of the fauna in general, several of the naturalists direct attention to the presence of Mediterranean types, and in the case of the characteristic arachnids, Mr. R. I. Pocock shows that Mediterranean and Ethiopian elements prevail. Zoologically the Sokotran islands may be placed in the great semi-desert region or subregion that extends from the Atlantic to the Indus, but there is a considerable admixture in the fauna of Ethiopian representatives.

Geologically the islands consist of the remains of a plateau composed of almost undisturbed Upper Cretaceous and Eocene strata, resting upon granitoid Archæan rocks which protrude through their sedimentary covering in places and form peaks. The most conspicuous of the sedimentary formations are Nummulitic and Alveolina limestones, and "Rudistenkalk" with Radiolites, as in many other parts of the ancient Mediterranean area. According to the British observers, volcanic rocks of the Aden series are intrusive in the limestones.

It is clear, and on this all are agreed, that the Sokotran islands, although separated from Somaliland and Arabia by sea several hundreds of fathoms in depth, were once a part of the continent, and probably were connected with both Asia and Africa, but it is equally clear that the peculiarity of the fauna indicates long isolation, probably since Pliocene, if not from Miocene times.

In conclusion, whilst it is easy to point out omissions, it is only justice to say that in the publication of the present volume a difficult undertaking has been brought to a successful conclusion, and that all concerned in the production of the work deserve congratulation for having contributed so important an addition to zoological science. The present volume is much more nearly complete than most works of its kind, and has been brought out with praiseworthy despatch.

Of the two accompanying illustrations taken from Dr. Forbes's narrative of the journey, one affords an idea of the characteristic scenery in the Archæan Sokotran hills, and the other is an example of the peculiar vegetation of the island. W. T. B.

THE FOOD AND DRUGS ACTS.[1]

THE consideration of the circumstances which occasioned the epidemic of arsenical poisoning in the latter part of 1900, arising from the consumption of beer brewed from materials which were subsequently proved to contain large quantities of arsenic, and of the facts which resulted from their inquiry into the conditions under which other articles of food are actually prepared on a manufacturing scale, has led the Commissioners to direct attention to the extremely limited official control possessed by local authorities who are charged with the administration of the Acts relating to public health and the sale of food over the operations of manufacturers. The Commissioners point out that the existing machinery of public health administration provides little, if any, system of official control over the proceedings of manufacturers of food or of food ingredients. An individual or a company may start the manufacture of some new composition of food, to be sold under a "fancy" name, but there is no obligation to satisfy the local or any other public authority that the composition or the ingredients are wholesome, or that the conditions of preparation preclude the possibility of contamination by deleterious substances. The sanitary authorities of certain districts have obtained powers, under local Acts, to supervise the conditions of manufacture of ice-cream, but the principle is of extremely limited application in effect, and, broadly speaking, the control which can be exercised becomes available only after the food is on sale to the public. But even then the power possessed by the local authority under the Sale of Food and Drugs Acts is extremely circumscribed. Section 3 of the 1875 Act was drawn with the object of preventing adulteration of food with substances injurious to health, but it is so worded that it is almost impossible to obtain convictions under it, and as a consequence local authorities seldom proceed under it. A notable illustration of the impotence of the section was seen in the cases of prosecutions against publicans for selling arsenicated beer, where the proceedings were almost invariably laid under Section 6. Most persons are agreed that arsenic is a deleterious substance, but it was much easier to convict the publican of selling beer to the prejudice of the purchaser which was not of the nature, substance, or quality demanded than of selling beer containing a poisonous ingredient, to wit, arsenic. The irony of the situation is accentuated by the fact that whereas the fines under Section 3 have some relation to the gravity of the offence, and are sufficiently large to be deterrent, under Section 6, which was aimed at an entirely different class, they may be, and frequently are, wholly trivial.

Another illustration of the inadequacy of the section is seen in the case of "preservatives" in food. A departmental committee appointed by the Local Government Board has reported that in its opinion certain "preservatives" are noxious and deleterious, and has recommended their prohibition in articles of food. The Local Government Board has, as yet, done nothing with the report, but various local authorities, finding their hands strengthened by the body of evidence which the committee accumulated, have been emboldened to take steps to check the widespread use of such substances as boracic acid and formalin in connection with milk, but their action is seldom, if ever, brought under the section which imposes a stringent penalty on any person "who mixes . . . any article of food with any ingredient or so as to render the article injurious to health with intent that the same may be sold in that state," but under the section which affords a chance of the magistrate saying that milk *plus* preservative contains more than the purchaser bargained for, and was therefore not of the nature, substance, and quality demanded.

The difficulty, of course, in Section 3 is to prove knowledge and "intent" on the part of the seller, but there is very little doubt that if convictions could be more readily gained under Section 3 the use of preservatives would receive a much needed check.

A public department may, however, be spurred into activity when its interests are jeopardised, and here again beer supplies us with a notable illustration. Beer, as we all know, furnishes much of the revenue of this country, and anything which affects the interests of beer may *pro tanto* be held to affect the

[1] See the article in last week's NATURE, p. 179. The papers referred to are (1) Final Report of the Royal Commission appointed to inquire into Arsenical Poisoning from the Consumption of Beer and other Articles of Food or Drink. (Parliamentary Paper. Cd. 1848. 1903.) (2) Final Report of the Departmental Committee appointed to inquire and report upon the desirability of Regulations under Section 4 of the Sale of Food and Drugs Act 1899 for Butter. (Parliamentary Paper. Cd. 1749. 1903.)

interests of the Revenue. Accordingly the Revenue authorities look pretty sharply after the brewers, and exercise considerable powers with regard to the ingredients which may be used by them. By the Customs and Revenue Act of 1888 the Commissioners of the Treasury have power to prohibit, by issue of an order published in the *London Gazette*, the use in the manufacture or preparation for sale of any article of excise, of any "substance or liquor of a noxious or detrimental nature," or which, "being a chemical or artificial extract or product, may affect prejudicially the interests of the Revenue," and it was in terms of this Act that the Commissioners of the Treasury, acting under the advice of the Commissioners of Inland Revenue, prohibited in 1901 the use of arsenicated glucose and "invert" sugar in the manufacture of beer under a penalty of 50*l*. To the plain man there is an element of humour—grim humour, it must be admitted—about this procedure. Apparently such is the condition of the Statute Book with respect to official control in the interests of public health of the manufacture of articles of food and drink that this is the only known administrative method of arresting a grave public danger—unless, indeed, the incriminated material is of such a character that it may be taken in transit, and that the whole of it may be brought before a magistrate in a police court by direction of a medical officer of health. The action of the Treasury is, it will be observed, restricted to articles of excise, and is exercised ostensibly solely in the interests of the Revenue. No action was, or apparently could be, taken by the local authority in the district in which the works of Bostock and Co. were situated to seize or otherwise deal with the large quantity of contaminated glucose, "invert" sugar, and table syrup stored at these works after their poisonous nature was discovered.

Apart from the injunctions they have laid upon the excise authorities to extend the application of the powers they already possess to ensure the purity of beer, the chief outcome of the Commissioners' protracted inquiry has been to formulate a series of recommendations, or rather propositions, as to the necessity for more extended administration by the Local Government Board; as to the necessity for official "standards" for purposes of the Sale of Food and Drugs Acts; as to the responsibility of the manufacturer or intermediate vendor—that is, apart from the retailer—under the Sale of Food and Drugs Acts; and as to the extension of the powers of local authorities to prevent the sale of suspected foods pending analysis.

With respect to the Local Government Board, the Commissioners are of opinion that this department ought to have the services of a special officer with scientific knowledge, who should be in relation with the Government Laboratory, and be able to institute the necessary chemical inquiries, and in other ways (for instance, where physiological investigations are necessary) have adequate assistance In this way the Commissioners think that full and authoritative investigation could be made where risks to health are suspected, or where new colouring matters, preservatives, or other chemical additions to food are introduced. The officer ought not only to have the duty of collecting information from public analysts and other local officers, and of advising how the Sale of Food and Drugs Acts may be efficiently worked, but he should be required to make inspections and inquiries as to conditions of food-manufacture at home and abroad. Under the improved condition thus contemplated, the Local Government Board should for such purposes be in touch with other public departments which might be able to render assistance in special directions, *e.g.* the Board of Inland Revenue in the case of excisable articles, the Board of Customs in the case of imported foods, and the Patent Office in the case of patented processes of food preparation.

The Commissioners are of opinion that the Local Government Board should be the authority to prescribe and from time to time vary "standards" for the purpose of the Sale of Food and Drugs Acts. By the Act of 1899 the Board of Agriculture has been empowered to make regulations, which may imply "standards," with respect to milk, cream, butter, or cheese, articles which—and especially the first-named—are more frequently the subject of prosecutions under the Acts than any other food substances. There is a slight difference of opinion as to the manner in which these "standards" should be arrived at. The majority of the Commissioners favour the establishment of a so-called Board of Reference, which they define to be a permanent body consisting of a small number of scientific men nominated by the Crown or departmentally. The principal of the Government Laboratory, who, apparently, does not dissent from the idea of a consultative board to advise on points connected with the Sale of Food and Drugs Acts, thinks that it would be preferable to follow the procedure of the Board of Agriculture and to entrust the consideration of the propriety of fixing a standard, or standards in the case of particular groups of allied substances, to specially constituted committees, appointed *ad hoc* and for the occasion, in which manufacturers and technical experts were represented. There is, no doubt, much to be said on both sides of this question, but considering the very large and legitimate commercial interests involved, it is questionable whether public opinion would be wholly satisfied by the exclusion from the board of persons of special knowledge and experience of the article for which a "standard" is required.

After all, the number of substances, or groups of allied substances, for which "standards" would be required is not inordinately large.

A matter of more immediate importance is the nature of the amendment which is required to bring home to the real offender the responsibility for a contravention of the Acts. At present the actual manufacturer of an adulterated article is too frequently allowed to escape, and owing to the difficulty of reaching him, local authorities are often unwilling to take action, on the ground that they do not regard the retailer, who has had nothing to do with the contamination and is frequently not in a position to know that it exists, as the really culpable person. Warranties are very difficult to take action upon, and the conditions which have to be complied with under the Statutes are so numerous and so exacting that it is well nigh hopeless to proceed. If a warrantor states that at the time of giving a warranty "he had reason to believe that the statements contained therein were true," he has a good defence. As the law stands at present it is rarely worth while to attach the manufacturer or middleman to the prosecution.

The particular method of arriving at a food-standard advocated by Dr. Thorpe is well exemplified by the second of the two Parliamentary papers under review. In July, 1901, the departments concerned appointed a committee to inquire and report as to what regulations, if any, may with advantage be made under Section 4 of the Sale of Food and Drugs Act 1899 for determining what deficiency in any of the normal constituents of butter, or what addition of extraneous matter or proportion of water in any sample of butter shall for the purposes of the Sale of Food and Drugs Acts raise

a presumption that the butter is not genuine. In its first report the committee, which was a large and representative one, consisting of analysts, producers, vendors, and public officials connected with the English and Irish Boards of Agriculture, under the chairmanship of Sir Horace Plunkett, after hearing evidence in this country and in Ireland, unanimously recommended the adoption of a limit of 16 per cent. for the proportion of water, and this recommendation was promptly given effect to in the Sale of Butter Regulations 1902.

In the present report the committee deals with the other matters referred to it. These questions have led it to inquire into the chemical nature of butter, to ascertain how far the composition of butter-fat is dependent upon conditions of production and within what limits it may vary. It has also had to inquire into the nature of the substances which may be used for the purpose of adulterating butter, and what methods are open to analysts to detect and determine the extent of such adulteration.

The space at our disposal precludes any attempt to deal in detail with the many interesting points connected with the chemical nature of butter which have come out in the course of the inquiry. Observation has shown that the chemical constitution of butter-fat is dependent to a certain extent upon climatic conditions, period of lactation, nature and amount of food, breed and idiosyncrasy of the cow. The extent to which its composition may vary from these several causes is shown in the evidence which was taken, and which is summarised in the report.

The majority—one member, a butter vendor, alone dissenting—were of opinion that for the purposes of the Sale of Food and Drugs Act 1899 it was expedient to recommend a limit or "standard" based on a deficiency in the normal constituents of butter, and that it was desirable that the limit should have regard to what all authorities are agreed are the characteristic constituents of butter-fat, namely, the volatile acids, which by general consent is by far the most important criterion in butter analysis. They recommend, therefore, that if the amount of the volatile acids in any sample of butter, as determined by the Reichert-Wollny method—a description of which is appended in a schedule to the report—should fall below the number 24, a presumption should be raised that the butter is not genuine. Two members of the committee are disposed to place the limit at 23.

The committee is strongly impressed with the necessity of taking such steps as would directly identify margarine if present in butter, and with this view it recommends that all margarine made or imported into this country should be "ear-marked," as is done in Germany, Austria, and Belgium, and as it is proposed should be done in France, by the addition of 10 per cent. of sesamé oil during its manufacture.

It further suggests that steps should be taken to give effect to the recommendations of the Dairy Congress held at Brussels on April 27 and 28, 1902, to secure international agreement on the subject of control of the manufacture of butter and margarine. In a large number of the countries producing butter for sale in this country a system of control more or less well organised and under State authority already exists, and there ought to be little difficulty in securing by international cooperation and agreement that the system should be uniform and effective.

It remains to be seen what the Minister of Agriculture will do with a report which is particularly interesting as a contribution to the literature of a subject of great importance to the community, and is evidently the carefully digested result of an exhaustive and complicated inquiry.

THE JANUARY METEORS.

THESE meteors shoot from a point at about 230° + 53° in Bode's modern constellation Quadrans Muralis, placed in the barren region between Boötes, Draco, and Hercules. But the former constellation has never been generally recognised and admitted into recent star-maps. The name "Boötids" has, in fact, been sometimes suggested as preferable to "Quadrantids" for this new-year meteor-shower.

In 1904 the meteors will probably return in their greatest abundance on the nights following January 3 and 4, but the moon will unfortunately be full, and only the brighter members of the shower will be visible. But watches of the sky should be maintained on the early evenings of January 3 and 4, and also on the mornings of those dates (between about 5 and 7 a.m.) if the weather is sufficiently clear. A few large meteors are sure to be visible, notwithstanding the strong moonlight. In some years, when all the conditions are favourable, the display of January meteors is as plentiful as that observed during an average Perseid shower. The really active period of the Quadrantids (or Boötids) is usually very brief, being confined to a few hours. Meteors in the front of the stream begin to appear on about December 28, and the display seems practically exhausted on January 5 or 6. The radiant has a very low northerly position during the greater part of the night, and the meteors exhibit long flights and moderately swift motions.

W. F. DENNING.

NOTES.

M. ALPHONSE ROBERT, the energetic natural history collector who accompanied Dr. Forsyth Major some years ago in his expedition to Madagascar, and who only returned to England a few months ago from a three years' sojourn in Brazil, has just started on another collecting trip to the latter country, where his first destination is Para. The expenses of both the previous and the present expedition, which are undertaken in the interests of the British Museum, are borne by Mrs. Percy Sladen. M. Robert, we understand, intends to spend some time collecting at Para, and thence to ascend the Amazons into Peruvian territory. The specimens collected by M. Robert during his last trip have done much to increase our knowledge of the mammalian fauna of the Matto Grosso and adjacent districts of Brazil, and the novelties obtained have been from time to time recorded by Mr. O. Thomas in the *Annals of Natural History*. Among these are several new bats (one indicating a new generic type), a squirrel, and a new race of the crab-eating fox (*Canis thous angulensis*). M. Robert has also obtained a fine series of skins of the large and handsome brown woolly spider-monkey (*Brachyteles arachnoides*), a pair of which are now being set up by Mr. Rowland Ward for the British (Natural History) Museum.

THE report submitted at the second annual meeting of the trustees of the Carnegie Institution, held in Washington recently, shows that sixty-six grants were made by the executive committee for scientific research, amounting to an aggregate sum of 30,000*l*., the recipients of which represent every part of the United States and the smaller colleges as well as the large universities, observatories and laboratories. Twenty-five research assistants were appointed. These sums are exclusive of administrative and incidental expenses of the Institution. Arrangements have been made for publication at an early day of eleven scientific papers,

most of them making large and costly volumes. Among the subjects now under consideration by the Institution in connection with grants are a solar observatory, southern observatory, geophysical laboratory, Transcaspian exploration and archæological exploration, exploration in the south Pacific, establishment of biological experiment laboratories and international magnetic researches. The trustees authorised an aggregate expenditure of 75,000*l.* in grants for scientific researches and 8000*l.* for publications during the ensuing year.

The large gold medal for services rendered to art and science has been awarded by the German Government to Prof. Ehrlich.

The French Minister of Public Instruction has been authorised, says *La Nature*, to prepare a Bill arranging for the creation of a chair of general physics in connection with the science faculty of the University of Paris. This chair is intended for M. Curie.

A Reuter message from Stockholm announces that Baron Erland Nordenskjöld's expedition to Peru and Bolivia will leave for Southampton on January 6. It will proceed thence to Panama, and will arrive about February 15 at La Paz, the capital of Bolivia, which will be the departing point for the expedition to Lake Titicaca.

The Brothers Kearton have arranged to hold an exhibition of enlarged photographs of birds, beasts, reptiles, and insects at the Modern Gallery, Bond Street, W., on January 2–12, 1904, inclusive. The Gallery will be open from 10 a.m. until 9 p.m., and Mr. R. Kearton will deliver limelight lectures to children each afternoon, and to adults in the evening.

The death on December 19 at Hove of Mr. John Henry Brown recalls the little-known fact that, as the inventor of the iris diaphragm, he has laid the scientific world under a considerable obligation. "In the early seventies," Dr. Hollis writes from Hove, "he took his home-made model to Smith and Beck, the predecessors of the well-known firm of opticians in Cornhill. This model he showed me, many years ago, and although roughly constructed it differed in no important detail from the type of apparatus at present in the market. As he did not patent the little contrivance he reaped no pecuniary reward for his ingenuity. Although frail in body and physically somewhat infirm, Mr. Brown by indomitable energy made and retained for many years a large practice as a dental surgeon. He was a fellow of the Royal Astronomical Society, and died aged sixty-seven much respected."

The President of the Board of Agriculture and Fisheries has appointed a departmental committee to inquire into and report upon the present position of fruit culture in Great Britain, and to consider whether any further measures might with advantage be taken for its promotion and encouragement. The committee is constituted as follows:—Mr. A. G. Boscawen, M.P., chairman, Mr. C. W. Radcliffe Cooke, Mr. J. M. Hodge, Colonel Charles W. Long, M.P., Mr. George Monro, Mr. P. Spencer Pickering, F.R.S., Dr. W. Somerville, an assistant secretary of the Board of Agriculture and Fisheries, Mr. Edwin Vinson, and Rev. W. Wilks, secretary of the Royal Horticultural Society. Mr. Ernest Garnsey, of the Board of Agriculture and Fisheries, will act as secretary to the committee.

At the meeting of the Institution of Civil Engineers on December 22, Dr. T. E. Stanton described experiments made in the engineering department of the National Physical Laboratory on the distribution and intensity of the pressure on thin plates and combinations of plates placed in a uniform current of air. The results show that, under the given experimental conditions, a definite relation existed and may be stated thus:—For similar and similarly situated plates or combinations of plates in a uniform current of air, the intensity of pressure is the same for the same velocity of current and general atmospheric conditions. On the assumption that the motion of the wind approximates to that of a uniform current, the distribution and intensity of the pressure of the wind on structures may be studied experimentally by means of models of the structures set up in a current of air produced by means of a fan. In illustration of this, the results of experiments made on models of roofs and lattice girders of simple form were given. Tabulated results are also given for the cases of parallel plates at varying distances apart, plates inclined at varying angles to the direction of the current, and rectangular plates of varying ratio of length to width.

Mr. R. G. Carruthers and Mr. G. W. Grabham have been appointed geologists on the Geological Survey of the United Kingdom.

Mr. L. M. Lambe has given a description of the lower jaw of Dryptosaurus obtained from the Cretaceous strata of north-western Canada (*Ottawa Naturalist*, xvii., November).

In our brief notice of Mr. R. B. Newton's article on fossils from Borneo (Nature, December 10, p. 139) it should have been distinctly stated that Trigonia was for the first time recorded from the Jurassic rocks of that island. The genus had previously been recorded from the Cretaceous strata of Borneo.

In the *Annals* of the South African Museum (vol. iv., part ii., November) there is a series of articles by Dr. R. Broom on fossil reptilian remains collected by officers of the Geological Survey of Cape Colony. He describes an almost perfect skeleton of *Pareiasaurus serridens*, some new theriodonts, including three new genera, also a new and primitive rhynchocephalian from the Karroo beds. This last reptile is named Proterosuchus, and it shows a considerable degree of specialisation along the line which gave rise to the early crocodiles and dinosaurs.

In the *Proceedings* of the Cotteswold Naturalists' Field Club (vol. xiv. part iii., November) there is an interesting historical and geographical article on the Cotteswold Hills by Mr. S. S. Buckman, who deals with the origin of the name and the area to which it should properly be restricted. Messrs. T. Pears and L. Richardson describe some alluvial deposits at Clifton Hampden, near Oxford, and Messrs. A. S. Kennard and B. B. Woodward contribute notes on the land and fresh-water Mollusca found in the deposits. Among the species it is interesting to note *Dreissensia polymorpha*, as the occurrence of this mollusc in Britain was first observed in 1824, when living examples were found in the Commercial Docks, and it was held that the species had been imported.

In the *American Journal of Science* (December) Mr. G. R. Wieland discusses Polar climate in reference to the evolution of plants and animals, expressing the view that the northern circumpolar area has probably been, ever since the older Palæozoic era, the main evolutionary centre from which animal and plant life have radiated. In the same journal Mr. J. C. Branner directs attention to the resemblance between the Peak of Fernando de Noronha and the intrusive plug or obelisk of Mont Pelée, in Martinique,

described by Dr. Hovey. He also quotes an interesting passage from Darwin's "Journal," in which the author remarked of the Fernando Peak that "at first one is inclined to believe that it has been suddenly pushed up in a semi-fluid state."

The veteran traveller, Baron F. von Richthofen, selected a geographical subject for his inaugural address as rector of the University of Berlin (*Zeitschrift der Gesellschaft für Erdkunde zu Berlin*, 1903, p. 655). In dealing with the motives and course of geographical inquiry in the nineteenth century, he includes a considerable review of the work of early explorers. Twenty pages, indeed, have passed before we come to the final fourteen in which his true subject is discussed. The personal aims and influence of the rector are thus somewhat modestly and rigidly suppressed, and the address assumes a strictly academic character. It is well pointed out that tales of fabulous gold have prompted a large part of exploration. Yet geographical discovery, from whatever motive, has ended in that widening of the field of view which forms the essential feature of human progress. The promoters of colonial enterprise, it is urged, commonly overlook this incalculable result of their endeavours. The author traces the rise of scientific geography from the stage of mere universal description, and points out how the culture of Germany has allotted its proper place in the university curriculum to a subject so intimately connected with the search after truth and the welfare of mankind.

In the *Physical Review* for October Mr. Edgar Buckingham gives a concise deduction of Stefan's law, according to which the total temperature radiation of a black body is proportional to the fourth power of the absolute temperature. This deduction, which is a modification of Boltzmann's, is based on the free energy principle, but the corresponding reciprocal thermodynamical relation can be used instead if preferred.

Dr. Marage publishes a series of observations on the artificial development and measurement of the sense of hearing in deaf mute subjects. A considerable number of cases were experimented on, a vowel-syren producing the sounds ou, o, a, é, i being adopted for the purpose, and curves were drawn showing the intensity of sound audible to the patients at different stages of the treatment, as measured by the air pressure necessary to render the sounds of the syren audible. The author maintains that there are but few subjects who are deaf and dumb beyond all cure, and that the use of the syren will often restore the power of hearing, even in cases of complete deafness, usually within about six weeks. The sounds, so far from being fatiguing or painful to the subjects, appear to give them genuine pleasure.

Prof. Giacomo Ciamician has published his inaugural address delivered in the University of Bologna on November 7, dealing with the problems of chemistry of the new century. After giving a general survey of recent advances in chemistry and physics, the author turns his attention to the problem of developing chemical industries in Italy. Already enormous strides have been made in the manufacture of iron and steel, of sulphuric acid (the production of which has increased fivefold in ten years), of sugar (in which the increase in five years has been from 50 to 800 thousand quintals), and of calcium carbide. Among the obstacles to further progress mentioned by the author are the action of the Government in checking the growth of new industries by excessive taxation, the timidity of capitalists, and the want of educational institutions for training an efficient army of expert chemists.

At the meeting of the Asiatic Society of Bengal at Calcutta on December 2, Mr. T. H. Holland exhibited a meteorite which fell with the meteor seen in eastern Bengal on October 22. The stone weighs 622 grammes, and is covered with a thin black crust formed by the fusion of the rock during its rapid flight through the air. Several stones were known to have fallen with this meteor, and the complete investment with fused crust of the one exhibited shows that fusion of the surface occurred after the break-up of the meteorite. Besides the complete proof that the meteor resulted in an actual fall of stones, special interest attaches to this occurrence on account of the observations made from so many points of view permitting the actual path and speed of the object to be calculated. At the same meeting Mr. D. Prain read papers on an undescribed Indian Musa and on an undescribed araliaceous genus from Upper Burma.

The October number of the *Journal* of the Royal Horticultural Society contains a brief description, with some illustrations, of a number of trees and shrubs recently introduced from China by Mr. Veitch, which seem to be suited to our climate, and may prove to be important acquisitions to our garden plants. As Mr. Veitch states, they have been chosen from the collections made by his agent, Mr. E. H. Wilson, and bear testimony to the latter's energy and assiduity. In the same volume the practice of watering cucumbers and tomatoes with copper sulphate in order to ward off fungal diseases is recommended by Mr. G. Massee.

The primary function of the park and garden committees in our cities and towns is to provide ornamental and open spaces. The members of the Bradford Parks Committee have recognised that it is within their province to afford educational facilities, and have set apart a plot of land in Lister Park to be converted into a botanical garden in which to present a systematic grouping of plants, and also to grow trees, and local or economic plants which will serve for the purpose of identification. It is within the scope of this scheme to provide material for teachers' use and to establish informal public lectures at which more interesting specimens can be shown and discussed.

In No. 6 of the *Publications* of the Conseil Permanent International pour l'Exploration de la Mer, issued at Copenhagen, Mr. H. M. Kyle describes a trawl-net designed to work in mid-water as well as on the sea-bed. This net, which is constructed on the umbrella principle, has been tried on one occasion at Grimsby, and, although the results were not entirely successful, may quite possibly prove efficient.

We have to acknowledge the receipt of the second part of Mr. J. Macoun's "Catalogue of Canadian Birds," published by the Geological Survey of Canada. This part includes the diurnal birds of prey, together with the woodpeckers, flycatchers, crows, jays, and American blackbirds (Agelæus). Three years have elapsed since the publication of part i. (which was noticed at the time in our columns), during which period much additional information has been acquired with regard to the distribution of Canadian birds; consequently this portion of the subject is somewhat more amplified in the present part than was the case in its predecessor. Otherwise, the mode of treatment follows the original lines.

We have received copies of the first six numbers of a series of circulars on agricultural economic entomology, in course of issue by the Trustees of the Indian Museum, Calcutta. Each number is devoted to a single species of

insect, of which it contains an illustration. In each instance the general appearance and mode of work of the insect are described, after which we have its distribution, food, and ravages, followed by a brief account of its general habits, and concluding with suggestions for remedial measures. No. 4 deals with the date-palm, or Indian rhinoceros-beetle, of which both the grub and the adult insect inflict very serious damage on the tree after which the species is named. The next part treats of the north-west, or migratory, locust, of which the distribution within the limits of the Indian Empire is shown on a map.

IN the December issue of the *Quarterly Journal of Microscopical Science* Prof. Ray Lankester figures for the first time a couple of small blind crabs of the genus Cymonomus (or Ethusa) taken so long ago as the cruise of the *Porcupine* (1869–70), and described by Canon Norman in 1873. The main reason for bringing these specimens into prominence is owing to a statement in a popular work that they belong to a species of which the form inhabiting shallow water has functional eyes, while as we proceed deeper and deeper the eye-stalks are found to be more degenerate. The statement that an eyed form exists is apparently a misconception, while the idea that the one in which the eye-stalks are the most modified inhabits deeper water than the other is likewise not well founded. As a matter of fact, Prof. Lankester believes the two specimens to indicate distinct species. The other contents of this serial include a discussion on the origin of the green cells found in a turbellarian worm (*Convoluta roscoffensis*) peculiar to Brittany, by Messrs. Gamble and Keeble, and a note by Dr. Hanna on the presence of Trypanosoma parasites in the blood of certain Indian birds. In a third article, Mr. H. M. Bernard continues the account of his investigations into the structure of the retina, dealing in this instance with the continuity of the retinal nerves throughout the Vertebrata.

IN 1902 Mr. R. Lydekker, F.R.S., read before the Zoological Society (see *Proceedings* Zoological Society, 1902, p. 981) the description of a new antelope from the neighbourhood of Lake Mwero, in northern Rhodesia. Mr. Lydekker supposed it to belong to the genus Cobus, although, as the only specimen consisted of a flat skin without head and feet, he was not quite certain where it should be placed, and named it *Cobus smithemani*, after Mr. F. Smitheman, who had obtained the specimen. Fresh and more perfect examples of this antelope have lately been received by Mr. Walter Rothschild, who has presented one of them to the British Museum. This specimen, which may now be seen mounted in the gallery, shows that Mr. Lydekker was quite correct in his judgment, and that Smitheman's antelope is a strongly marked new form of the "Kob" group, easily distinguished from the Poku or Vardon's antelope by its black neck and dark chestnut sides.

THE re-introduction of cotton cultivation into the British possessions on the Spanish Main is regarded as of sufficient importance to justify the devoting of the whole of the third part of vol. iv. of the *West Indian Bulletin* to the subject. One-third of the number contains reprints of articles, or portions of articles, in the "Encyclopædia Britannica" and in various publications of the United States Department of Agriculture. The remaining two-thirds gives much useful information bearing upon the cultivation of cotton in St. Kitts, Antigua, Montserrat, Barbados, and Carriacou; an article by Prof. d'Albuquerque on the agricultural chemistry of cotton; one by Mr. Lewton-Brain on the fungoid diseases of cotton; and an illustrated article by Mr. Henry A. Ballou on insects attacking cotton in the West Indies. Sir Daniel Morris, accompanied by Mr. Bovell, has spent the autumn in the southern States of America making an exhaustive examination of the methods of cultivation, and the preparation for market, of the Sea Island variety of cotton. The results of the investigation will be published as an extra number of the *West Indian Bulletin*, Sea Island cotton being thought to be the most suitable for the islands

UNDER the title of "The Case for Vaccination," Mr. C. E. A. Winslow gives an admirable survey of the statistical data in favour of the efficacy of vaccination (*Science*, July 24, p. 101). It points out that a single vaccination greatly reduces the probability of an attack of small-pox, postpones it to a later period of life, and renders it less dangerous if it does ensue. To ensure absolute protection revaccination is required. During the small-pox epidemic of 1871, of 734 nurses and attendants in the Metropolitan Asylums Board Hospitals 79 were survivors from small-pox attack, and escaped infection; 645 were revaccinated on entrance, and all escaped; 10 were not revaccinated, and all took small-pox. Mr. Winslow concludes, "if statistics ever proved anything, those quoted prove the protective influence of vaccination. If any fact in science is certain, it is that a successful vaccination absolutely prevents small-pox for a period of from seven to ten years, that after that period it renders the disease less fatal, and that its complete protective effect may be renewed by revaccination. The conclusion is obvious not only that the State should oblige primary vaccination, but that a second vaccination at the age of twelve ought to be made compulsory."

THE latest addition to the convenient little scientific memoirs published in the "Scientia" series by M. C. Naud, of Paris, is a translation of two papers by Prof. J. Willard Gibbs which appeared in 1873 in the *Transactions* of the Connecticut Academy, and have become scientific classics. "Diagrammes et Surfaces thermodynamiques," as the book is entitled, is by M. G. Roy, of the University of Dijon, and the translation is preceded by a biographical notice of Prof. Gibbs by M. B. Brunhes, of the University of Clermont.

MR. WILLIAM TAYLOR has recently circulated a pamphlet with the title "The Science of the Engineering Workshop," in which he urges the need for making scientific knowledge readily available to those at work in engineering shops. He then proceeds to trace—under the three headings, materials, processes, and tools—the foundation and outline of this science of the workshop. The publication concludes with the syllabus of a course of instruction, largely the work of an advisory committee of engineers, in the science of the workshop which is in use at the Leicester Municipal Technical Schools.

THE annual report of the Smithsonian Institution for the year ending June 30, 1902, has reached us, and an examination of the volume shows it to be of the same valuable character as its predecessors. The proceedings of the Board of Regents, the report of the executive committee, and the annual report of the secretary are followed by the usual interesting general appendix. The appendix constitutes nearly five-sixths of the whole contents of the volume, and comprises brief accounts of scientific discoveries in particular directions during the year with which the report is concerned, and the method adopted is to present a miscellaneous selection of papers embracing a considerable range of scientific investigation and discussion. Many of these contributions are familiar to readers of NATURE, since some of the papers have already appeared in these columns,

and others have been published in the *Transactions* of British scientific societies. Among the reprinted articles we notice—to name a few—Prof. Dewar's British Association presidential address on the history of cold and the absolute zero; Prof. J. G. McKendrick's contribution to the study of experimental phonetics; Dr. J. J. H. Teall's address on the evolution of petrological ideas; and Mr. H G. Wells's Royal Institution lecture on the discovery of the future. There are several translations from French and German of important papers also included, such as Prof. A. Dastre's article in the *Revue des deux Mondes* on the life of matter; Dr. Georg Jacob's "Oriental Elements of Culture in the Occident" from the German; and Herr Oscar Israel's appreciation of Virchow from the *Deutsche Rundschau*. Like all similar publications from the Smithsonian Institution, the volume is provided with many excellent illustrations.

OUR ASTRONOMICAL COLUMN.

ASTRONOMICAL OCCURRENCES IN JANUARY, 1904:—

Jan. 3–4. Epoch of the January meteors (Radiant 230° +53°).
5. 10h. 13m. to 11h. 9m. Moon occults *o* Leonis (mag. 3·8).
12. 10h. 11m. Minimum of Algol (β Persei).
,, 15h. 0m. Ceres in conjunction with moon. Ceres 0° 58′ N.
15. Venus. Illuminated portion of disc = 0·707.
,, 6h. 58m. Minimum of Algol (β Persei).
27. 0h. 0m. Vesta in conjunction with moon. Vesta 0° 21′ N.
28. 4h. 55m. to 8h. 8m. Transit of Jupiter's Sat. III. (Ganymede).
,, 8h. 0m. Venus in conjunction with Uranus. Venus 1° 47′ N.

EPHEMERIS FOR WINNECKE'S COMET.—A second part of the ephemeris for the 1903–4 appearance of Winnecke's comet is published by Herr C. Hillebrand in No. 3916 of the *Astronomische Nachrichten*, from which the following has been taken:—

Ephemeris 12h. (*M.T. Berlin*).

1904	α app. h. m. s.	δ app. ° ′ ″	log. r	log. Δ
Jan. 0	17 30 51	−17 46 46	9·988836	0·272241
,, 4	17 50 44	−18 39 19	9·981012	0·270012
,, 8	18 10 59	−19 24 20	9·974601	0·268606
,, 12	18 31 32	−20 1 5	9·969782	0·268027
,, 16	18 52 16	−20 28 58	9·966085	0·268248
,, 20	19 13 4	−20 47 33	9·965417	0·269255
,, 24	19 33 50	−20 56 41	9·966004	0·271006
,, 28	19 54 27	−20 56 24	9·968430	0·273468
Feb. 1	20 14 47	−20 46 57	9·972633	0·276601
,, 5	20 34 46	−20 28 49	9·978474	0·280344
,, 9	20 54 18	−20 2 38	9·985794	0·284645
,, 13	21 13 19	−19 29 13	9·994414	0·289439
,, 17	21 31 45	−18 49 25	0·004129	0·294662
,, 21	21 49 35	−18 4 11	0·014739	0·300253
,, 25	22 6 47	−17 14 26	0·026059	0·306155
,, 29	22 23 20	−16 21 3	0·037913	0·312312

SPECTRUM OF MIRA CETI.—In No. 5, vol. xviii., of the *Astrophysical Journal*, Mr. Joel Stebbins, of the Lick Observatory, gives the results of a study of the spectrum of *o* Ceti made with the 36-inch refractor during the period June, 1902, to January, 1903, in which period the magnitude of the star decreased from 3·8 to 9·0. The spectra were obtained with spectrograph i.—which is the Mills spectrograph converted into a one-prism instrument—attached to the 36-inch, and a spark between iron poles was always used as the light source of the comparison spectrum.

The absorption spectrum obtained is not very like the solar spectrum, but the calcium lines *g*, H and K are all present, *g* being comparatively much more intense than in the solar spectrum; the iron lines are not prominent, and even the strongest do not appear when a small dispersion is employed. The *g* line undoubtedly becomes broader as the star grows fainter, for on June 27 (mag. = 3·8) its width was 2 t.m., whilst on September 6 (mag. = 7·0) it was 9 t.m. The lines at λλ 3990·64, 4045·16, 4093·55 and 4097·08 respectively, which are apparently not coincident with solar lines, appeared at successive intervals during the diminution of magnitude.

A comparison of the several spectra shows that with the decrease in the star's magnitude the continuous spectrum from λ 4300 to λ 5000 becomes relatively fainter than that between λ 4000 and λ 4300.

The bright hydrogen lines are very prominent, and Hβ and Hε, which have been reported as absent by other observers, appear on all the dense negatives, and they appear to grow relatively stronger than the other hydrogen lines, and the continuous spectrum, as the star's magnitude decreases. In addition to the hydrogen lines, bright lines of Si, Mg and Fe are probably present, and numerous changes took place in their relative intensities during the interval covered by the spectrograms. For example, the line at λ 4007 undoubtedly disappeared altogether, whilst the line at λ 4571—possibly due to magnesium—developed in a remarkable manner. The latter did not appear at all until the star's magnitude had fallen to 5·4, and afterwards it became the most prominent feature of the whole spectrum. The evidence obtained supports the conclusion that the bright hydrogen lines disappear at minimum.

Determinations of the star's radial velocity showed that it remains constant at about +66 km., and this is held to be a strong argument against the theory that the light-changes are due to the existence of a companion. The abnormal changes in the relative intensities of the hydrogen lines—which are displaced from their normal positions towards the violet, apparently by other causes than radial velocity and pressure—lead Mr. Stebbins to the conclusion that the light changes are due to internal causes which produce effects that are, as yet, unfamiliar to us.

THE "COMPANION TO THE OBSERVATORY," 1904.—The 1904 edition of the well-known annual compendium of astronomical data, the "Companion to the Observatory," is very similar to that of 1903. It contains, amongst other information, the usual tables for solar, lunar and planetary observations, ephemerides for the various satellites, and minute data regarding a large number of variable stars.

Mr. Denning has contributed a set of notes regarding the principal meteor showers, and Mr. Maw has supplied a list of double-star observations, whilst the numerous variable star ephemerides have been taken from advance proofs supplied by M. Loewy.

OXFORD AND SCIENCE.[1]

WHEN I am tired I sometimes go by train to Reading and cycle over here swiftly in the afternoon, and then I dress and dine comfortably at the *Mitre* and go out for a stroll. Perfect rest is not possible unless there is moonlight, but Oxford is always wonderful and satisfying and restful to an engineer like me. It is not because of its age, of the great men who have studied and worked in its colleges, of its almost unique character and high rank among universities, of the sacred beauty of its colleges and streets. It is because that to me it represents what is most persistent in the constitution of the British Empire. The Houses of Parliament, Westminster Abbey, the Temple and City of London, Windsor, the great mansions of our English nobles, each of these suggests much to any man who is fond of reading, but each suggests only a small part of what Oxford represents.

Now the thing that pervades all my thoughts of Oxford is that more than half of the most distinguished Englishmen during four hundred years have been educated here. And if, as I sometimes do, I include Cambridge when I say Oxford, all the most distinguished Englishmen during four hundred years have been educated here.

Whether we like it or not, it is a fact that England is an aristocratic republic with the King at the head of the

1 An address delivered by Prof John Perry, F.R.S., at a public meeting in Oxford, arranged jointly by the Ashmolean Natural History Society of Oxfordshire and the Oxford Mathematical Society.

aristocracy. There is a disadvantage in almost all our rulers being selected from a limited class. But in the democratic republics of America and Europe there is the far greater disadvantage that the nation seldom commands the public services of rich or cultured men or men of family. Here there is no man so high in rank, or so rich or so intellectual, that the nation cannot command his willing services. Again, there never in the history of the world was an aristocracy like ours, admitting new men in every generation, allowing a constant flow of its younger sons downwards. Americans may gibe, and some of the younger of us may rail, but this system of government is beloved of all people in England, rich or poor; it is so much a part of the English constitution that no student of history can imagine an England governed in a different way, and this aristocracy will retain its power over a believing people until the time comes when it ceases to believe in its own self. At any one time it is only a minority of undergraduates who belong to the ruling caste, but the important thing to think of is that practically every member of the ruling class of England passes the four most important years of his life in Oxford (or Cambridge). All the rest of his life he looks at things through Oxford spectacles. His father and his father's friends were Oxford men. His mother and his aunts have always been under the influence of Oxford clergymen; even the lighter literature and journalism of the household are from Oxford pens. Until he leaves his nursery, under his earliest tutors, in his preparatory school, in a public school, every tutor he has had, every influence round him, have been dominated by Oxford feelings.

When at an age of from twenty-one to twenty-four a young man enters Parliament or diplomacy, or any of the reserved parts of our public services, his character is formed; all his ways of thinking and his prejudices are on the models most revered in Oxford. His early youth has been influenced by Oxford of the past, his undergraduate ways have influenced and been influenced by Oxford of the present, and his prejudices, kept strong by loving memories, exercise an influence against all changes in Oxford for the future.

I have often thought that Darius and his companions, the sons of the ruling families of Persia, had a most delightful education. We do not hear much of their love for literature or what we should call school-book work. Their education was in companionship with each other and with their wise fathers and their friends; in military exercises and in sports. Young gentlemen of England have always had that sort of education. It was probably best in Plantagenet times, when, indeed, a well trained young gentleman was not only very healthy and courageous, but he had not much chance of becoming lazy; he had the opportunity, denied to the lower classes, of becoming fit to lead in warfare, fit to assist in all that then constituted the government of his country. But when the positions hitherto monopolised by great ecclesiastics became possible for laymen, if these laymen possessed the necessary learning, youths of the higher class began to go to Oxford, and in the times of Queen Elizabeth and James there was real liberal culture among them such as had never been before and has never been since. To go to the university then became fashionable, and remains fashionable with youths of our higher classes.

What is the nature of the education now given to one of these young men? His father, a man of consequence in his county, perhaps in the legislature, probably experienced in public duties, with much knowledge of men, has played with him in his infancy, and keeps in touch with him always. Even from infancy he has been in contact with the great people of his time. No book work, no lectures were needed in teaching him the manners of his class. He cannot help acquiring the virtues of the aristocrat; his personal honour is dear to him, he always speaks the truth, he scorns all meanness, he respects the rights of others of his own class, and, indeed, of all others in so far as he understands that they have any rights. He shoots well and rides well. For some generations back he has been cleanly in his person, and he has been temperate and keeps healthy of body. Whatever becomes a custom of his class he follows as a law. Loyalty to his class and to the head of it are his creed. On the other side, he is ignorant of all knowledge that has not come to him by actual observation. His sympathies outside his own class are very limited and conventional. His traditions are to the effect that only one man in a hundred takes heartily to school work, to book work, to learning; that the average man of his class does not go to Oxford for learning. He goes to finish his education, to meet and make friends with men who are to share with him later on in the government of the country. Healthy as an otter, unflinching as a fighting cock, faithful and courageous as a bulldog, clean as a cat, in far more intimate companionship with men than he ever will be again, he admires or makes close friendship with or mildly dislikes these equals. His connection with the university is small; his college is everything; tutors were created for him. He learns the value of public opinion; he learns that ginger may be hot in the mouth, and yet he is surrounded by such police arrangements that he is guarded from ruin even when he is most reckless. Truly it is a wonderful experience, a valuable education, and it is never through book work or lectures, but from actual experiment and observation that the average young Englishman ever has or had any kind of education. Darius and his young companions were well fitted to rule, but they probably could neither read nor write. The average young man who leaves Oxford with or without a pass degree forgets very soon what book work, what learning, he ever had, and he dislikes reading. He has always been laconic in speech, and finds a small vocabulary quite large enough for his needs. He has successfully cultivated an appearance of want of vulgar interest in anything, so that want of practice begins to tell upon his powers of observation, and his resourcefulness tends towards that of the ostrich. It is fondly assumed by his tutors that, although he soon forgets his Latin and Greek, yet his study of these was the medium of much mental training; that the study of Euclid and logic have given him a logical mind. I cannot deny that there may have been some mental training through Latin, but I assert—it is, of course, mere assertion—that it has not been much. On the other hand, I assert that much harm has been done, for his hereditary prejudices against all book work, all learning and literature have been deepened. For the few men of his own class who take kindly to literary studies he has a respect not untinged with doubt. Between him and the real student not of his own class there is a great gulf fixed, like what there is between him and clergymen.

Observe that I am not here referring to the education of the real students. For them, it is true in a very limited range of subjects, but for them there is the most wonderful education ever known.[1] They also make friends for life, they take fire at each other's ideals as only young men can, they meet every day the great scholars of their age who are also students, and there is always a fine education in the mere contact with men worthy of young worship. Young men like this need but little teaching; they are fond of books and educate themselves.

It is easy for an outsider to overpraise this education, because the glamour of the beautiful college life is on all his thoughts; he does not at once observe how narrow the culture has always been, and how now the examination system is cramping it more and more. Oxford is hard, unspiritual and idolatrous, and the absence of scientific method is evident everywhere. Oxford is like a technical school, training these better men for the higher posts in the Church, in the Civil Services, in journalism, at the Bar, and in boys' schools. And it is found that these successful men have dwarfed imaginations and no power to think for themselves in any subjects outside their narrow professional grooves. The barrister who seems inspired in the Law Courts is mute and inglorious in the House of Commons. The readers of the hundreds of newspaper

[1] Just nine days ago I gave a short address on the twentieth anniversary of the opening of College Hall, London. It is a hall which Lady Lockyer, her sister and her friends started for women students attending medical and other college courses where they might have that companionship without which there can really be no higher education. It is curious that this should be the only college hall in London, that London should be so well provided with university professors and lecture rooms and laboratories, and that the equally important colleges of residence should be non-existent. A great city like London needs such halls far more than Oxford did when William of Durham and Walter de Merton began to build.

articles of any morning—as like one another as herrings—are awed with their display of culture, of depth of thought, of knowledge, and with what is more astounding than anything else, an infinitely perfect Oxford polish. Watching the performances of an Oxford man of letters is like watching a good billiard player or a skilled musician. His mind is filled with the thoughts of other men, pigeonholed, ready for use. He thinks those thoughts to be his own, and he never takes in the real meaning of the fable of Diogenes and the lantern. He does really think for himself in that part of his trade which is personal to himself, and he has an abundance of all learning except what concerns those natural sciences the applications of which are shaking the social and intellectual world. He is never grossly unfair to other men who follow the rules of the game recognised by Oxford; against men of new ideas his struggle oft availeth. In dealing with some questions he is a genius towering to the heavens, in others he is like that same spirit imprisoned in a little bottle, sealed up magically by the mere name of some wise man of antiquity.

It is very noticeable that the Oxford man has retreated from the renaissance position and has gone back to the mediæval. He believes in his soul that there is no new thing under the sun; truth is not a thing to be discovered, it is something already revealed in Hebrew and Greek books. Even if a man is doing research it is after the poison has entered his system; his individuality has been practically destroyed. But for the present I am neglecting these real students. I am confining my attention to the average men of caste. These men are educated in the sense in which Darius and his friends were educated, excepting in this, that Oxford men do not know living foreign tongues, whereas the other barbarians did, and Oxford men pretend to know something of certain tongues that are dead. Every attempt to teach them by actual observation, actual experiment, actual trial, actual research, has succeeded well; every attempt to teach them by mere talk, by abstract reasoning, has failed.

And the world now to be governed is getting more and more complex. Man is utilising the energies of nature in thousands of ways unknown to the ancients. Common people are all getting educated. Where the ancients wondered and trembled, we understand and give orders to nature. The average unit of any population was compelled to be what we now call an unskilled labourer.

Now our labour is becoming more and more skilled. Are you aware that from one ton of coal there is as much energy, as much actual work, as may be done by forty thousand good labourers in a ten hours' day? Our best steam engines utilise only one-tenth of this energy at the present time. But even now we know that the cost of the most unskilled work done by man is one thousand times the cost of the same work wherever it may be done by the best steam engines. One fact of this kind properly considered is worth many long essays about the effect of the engineer in altering all the character of our civilisation. It is labour that is the true standard of wealth. The steam engine has added incalculably to the wealth of the world. We forget that man is no longer needed for unskilled labour, so that when we use unskilled labour we are using the materials which God has given us in the most inefficient manner possible. Furthermore, it becomes sweated labour, it unduly taxes skilled labour, it starves invention, and it brings up base, ill-fed families.

I do not think that a fact of this kind would have been neglected by the philosophers of Greece or the learned men of Rome, but when some of us direct attention to it and its neglect by modern philosophers, we are sneered at as Philistines; when we say that the nation which does not pay great attention to the practical application of scientific knowledge of nature must cease to exist, we are jeered at. We are low mechanical persons enacting the part of the fat boy in "Pickwick," "I'se goin' to make your flesh creep!" It is a curious kind of culture which scorns the lessons of history, the study of man in his relation to nature, the study of the enormous new forces which are now affecting the relations of nations to one another. Are you learned misers going for ever to gloat in secret over your learning or to edit for ever the same Greek texts, or for ever to spin new metaphysical philosophies out of your inner consciousness?

Are you for ever to labour over phrases and dogmas that have been endlessly discussed by the most acute intellects of all time? If through a practical study of palæontology or biology you could get really to understand the great discovery of Darwin (and you cannot possibly get to understand it from books alone), you would see that the oldest puzzles of children and philosophers, from the shepherds of ancient Idumea to the dons of Oxford, have been solved for ever. Have you for one moment any idea of the magnificent new problems that are now before us, of the wide outlook on the universe, the comprehensive grasp of what is great and what is little, which is possessed by naturalists? For one man who knows his English literature, who revels in Shakespeare, are there not ten in Oxford who scorn all literature which is not at least 1800 years old? If you must meditate about your thoughts and emotions, why not begin with some experimental psychology? Why is there so little research of any kind in any subject going on in Oxford? The study of the Greek language through Herodotus is called *history*. The study of the Greek language through the early fathers is called *theology*. The New Testament is degraded into a Greek text-book. The Iliad and Odyssey are only Greek exercise books. The clear gushing spring of the desert beloved of Erasmus and More is now trampled into dirt by innumerable dromedaries. Is it any wonder that the average healthy young Englishman whose common sense has been developed through observation and trial should leave Oxford ignorant of your sand-ploughing scholastic exercise work? You have thought him stupid, and made him believe himself to be stupid, when he was only showing his wisdom. The mental training that he might have had, that he needs in life, that kind of training which his ancient Persian education cannot give him, where is it? When he was a very young boy you tried to teach him arithmetic for years, a cruel exercise. Now he does not know what a decimal is; when he borrows money at 5 per cent. per month he does not know that he is paying 60 per cent. per annum. If you had let him experiment, play at keeping shop, actually weigh things in ounces and pounds, or pay for them in shillings and pence, if you had let him measure things in inches and tenths of an inch, it would have been a pleasure for him to learn. If he had spoken French and German, and had been encouraged to chatter in those languages, he would not now be so ignorant. If you had encouraged him to read stories, if later you had not made all reading a school task, if you had encouraged him to describe things, to write accounts of what he had seen; if you knew how to teach anybody English, the language of his country, if you had refrained from putting geography and history and other English subjects all in water-tight school class compartments, he would now be fond of reading, he could use books, and he would go on educating himself for the rest of his life. You made him wear his soul out in learning off Euclid by heart—why did it not strike you that he ought to draw and measure, weigh and experiment, long before you tried to give him abstract reasoning of any kind? How is a boy to reason about things unknown to him? In the nursery he got mental training through everything he saw, everything he clutched. Oxford took charge of him scholastically at the age of seven, and from that time onwards his higher mental powers ceased to grow. His mental equipment suggests the item for bread in Falstaff's famous tavern account.

And he becomes a ruler of this great nation, his duty during war and peace being that of a scientific administrator. Times of actual war are few and short; in those times the people and property of unprepared nations are destroyed with a rapidity never known in the past. In all old times England was unprepared for war, but this did not then so much matter; in future the nation that has not prepared during peace for possible war, by the exercise of the highest scientific faculty, will certainly be destroyed.

I am afraid that Von Moltke would have laughed at the kind of education of Darius and his friends being regarded as sufficient in these modern days. Also the war between nations is quite intense in times of peace. The rulers of nations have to take care that their laws do not destroy

industries, that they develop the right sort of education of the people; that the people shall be so educated as to become resourceful, full of initiative and invention, capable of learning from experience, people of character. Again, if our rulers set a fashion of gibing at scientific things, at technical education, for example, through ignorance, it is not unimportant to know that the complete loss of trades like the coal tar industries may be more serious evils than the loss of several campaigns in war used to be. If the Prime Minister, or any other minister, gives an important post to a non-scientific man, it may not be harmful, but sometimes it may be very harmful indeed; it may lead to the appointment of many unscientific men or the disgrace of the scientific men already engaged in some department where science is all important. But the evil is very much more far reaching than one can describe in words. Want of science in the rulers means neglect of scientific education and method throughout the whole country.

For your man of caste is an Oxford man, and as a ruler of his country he regulates all sorts of courses of instruction and examinations for the army, the navy, the Civil Service, the Indian Civil, the Colonial, and all sorts of other services, and he takes care that all these shall be on Oxford lines. The higher permanent officials are chosen by Oxford standards. The members of scientific committees appointed to assist Government departments are chosen by Oxford standards. Do educational experts suggest reforms in education, it is Oxford that determines whether the reform is received sympathetically or otherwise. Probably nowhere is the influence of Oxford felt more than in the primary schools of the country.

I know you are proud that Oxford should have so great an influence, and I do not suppose you will pay any attention when I suggest that it may lead to national misfortune. If Oxford scholars were merely like so many monks in their monastery, living the lives, following the studies which they love, I would say nothing. The revenues so used up are, I think, of no great importance to the country, and busy men elsewhere can only be benefited in knowing that there are these lovely lamaseries where men are living in serene air apart from the struggles of the world, living what they think to be the higher kind of life, that of the amateur copying the lives of the scholars of Constantinople before they were so mercifully scattered in 1453, copying the meditative ways of the divines and hermits of the fourth and fifth centuries.

But the Oxford hermit is also a ruler of an empire in the twentieth century. Edward the Confessor was a saint, but some of us think that he was not a very wise ruler of England. Louis XVI., too, was an amiable man. The downfall of nations has generally come from the too great power of some quite amiable amateur persons or corporations. It is mainly through her too great influence on the ruling families of England that I consider Oxford to be dangerous.

What, then, is it that we want? We affirm that all so good as the development of the faculties of the average Oxford man may be, it might be enormously increased. He learns by observation and experiment; he and his forefathers have never learnt anything otherwise. Why not, then, increase for him these chances of observation and trial? Frankly confess that to develop his reasoning faculties through mere repetition of the text of Simpson's Euclid is an absurdity, that he cannot at all take in abstract reasoning; that the academic methods of teaching mathematics and its applications are what we all know them to be, mere frauds. Some of our Chancellors of the Exchequer are known to have been ignorant of arithmetic. There are fine jokes—jokes understood even by board school children—told about Foreign and War Ministers of England who were quite ignorant of geography. "Bless my soul, you don't say so—Actually Cape Breton is an island—actually. I must go to the King at once and tell him that our great expedition has been sent to an island!"

These are no longer jokes to me; I merely feel that it is extraordinary that a man can have been so educated as to be a good debater, to be able to make a fine speech, that he may have taken a degree at Oxford, that he may have passed examinations in classics, philosophy and mathematics, and yet be exceedingly ignorant, illogical, unscientific, and unable to do easy computation. Some of us say that it is only through the experimental study of natural science, and not at all through the classics, that the brain of the average Englishman can be educated on that side which is never educated at the present time. We say that he is never taught English, yet history and English literature are finer mediums for his education than ancient classics. We say that if when young he was taught to be fond of reading English—and every child may be made fond of reading—later on he would be able, and very willing, to use books, and that a man who is fond of reading and is able to use books keeps educating himself all his life long. But books alone at Oxford are not enough. They are not wise the men who think that lectures and books alone, and observing lecture-table experiments, can give men an acquaintance with the great discoveries in natural knowledge which are revolutionising the world.

Do you know the ballad about the Count Arnaldos who envied the old helmsman his weird and wondrous powers?

> "Would'st thou, thus the helmsman answered,
> Learn the secret of the sea,
> Only th se that brave its dangers
> Comprehend its mystery."

I know there are many men in Oxford who think, like the wistful Count, that they can get all things easily or from mere reading. But, in truth, to read "The Origin of Species," or treatises on geology or astronomy or physics or chemistry is a misleading performance unless the reader brings to the study that kind of mind which has been developed already by his own observation and his own experiment. My classical friends laugh at me when I say that I know much Greek literature through translations, and yet they pretend to be able to weigh scientific arguments without having made any practical study of science. At all events I know my defects. I know that although a translation may give me in every particular the meaning of a Greek author, it cannot give me the music of the old language; the reasoning and facts are mine, but not the emotion. And when my classical friends say that they can weigh scientific arguments I laugh, for there are parts of those arguments as much beyond their comprehension as scientific evidence is beyond the comprehension of a Chancery Court. Who can compete with a barrister in reading, in extracting the meaning of a written document? and yet barristers fail utterly in getting scientific knowledge from books.

Besides the aristocratic undergraduates you have a larger number of middle class men at Oxford who will succeed their fathers in the management, not merely of landed estates, but of much more valuable estates in the distribution and manufacture of things. The education of these men from infancy has been on the same lines as that of their superiors, but it has been much more artificial, and remains much less thorough to the end of the Oxford course. There is, however, the same contempt for books, for learning, and the same absence, not merely of knowledge of natural science, but of those scientific habits of thought and methods of approaching problems which experimental research tends to produce. They are proud of being Oxford men, and are even more strongly imbued than the others with Oxford utilitarian prejudices. They have studied mathematics—mathematics is useless in business. Natural science was said to be taught at Oxford, and no man seemed one bit the better for having studied it—natural science is useless in business. These men become the owners of factories the spirit of which ought to be scientific research; the competing factories in Germany, France and America are run by men of scientific method, and our men discourage reform in every possible way. The rule of thumb of their fathers and grandfathers is good enough for them. Their factories are so badly arranged that the works cost of any manufacture is twice what it ought to be, and the time taken is twice as great. They take eagerly to all sorts of quack remedies for bad trade; they are easy victims to fraudulent persons. These are the men who discourage all education in the people employed by them, managers, foremen, and workmen. They are what I call unskilled workmen, that is, unskilled owners of works, and it is Oxford which is to blame for their unskilfulness. It is astounding how quickly the thriving businesses of the fathers are decaying, how quickly unskilled owners of works are being eliminated,

but there is a new crop of them every year. The want of education of these men is very harmful to the country, and Huxley, Lockyer, Armstrong, Ayrton, Magnus, and other educational experts have written at great length upon the subject over and over again. If I thought that the expression *technical education* were understood at Oxford, I might, perhaps, try to ventilate this part of my subject, but it is quite misunderstood, and as these writers have failed to make any impression I think it better to let it alone.

Fifty years ago the Prince Consort started many good things agoing, and probably the most important was the Science and Art Department, the science classes of which under Sir John Donnelly forty years ago, greatly developed by Sir William Abney since, have given a better education in natural science to hundreds of thousands of poor boys than Oxford gives even now. I feel sure that it is this that has saved our industries from the jealous, hungry, persistent scientific foreigner. Wherever there is an owner of works whose common sense triumphs over his defective education, he gives a free hand to a manager who has been taught in these classes or in one of the technical colleges now springing up. These technical colleges are the natural outcome of Sir John Donnelly's work. I am glad to think that their methods are far removed from the soul-destroying methods of Germany; they are gradually becoming more and more perfect as British institutions. They illustrate the British experimental method of tackling an important problem. The one bar to their success is that the boys from all the schools of this country, primary and secondary, but particularly from those schools which are more immediately under Oxford influence, are quite unfitted by their school training to benefit by technical college teaching. The time of the professors and instructors is greatly wasted in correcting evils that are due to the schools. I think on the whole, however, that middle class England is slowly waking up to the importance of education. Every kind of education she has seen in the past has seemed to her not worth striving for, and her sleep has been very sound and very prolonged. But a kind of education is now being exhibited to her which seems as if it might give a fine sort of mental training, and as soon as middle class England sees this matter clearly as a thing worth having, the rule of old Oxford over many of our schools will cease. For Oxford has not merely induced neglect of science; she has been its active enemy pretending friendship. What schoolmaster from Oxford is there who does not see his existence threatened by science? Consequently, middle class England has been paying large premiums with its sons and yet seeing them fail to obtain employment, whereas board school boys are successful enough in reaching lucrative positions, although they have paid no premiums, and have been earning wages all their lives."

It is not the schoolmasters, it is the engineers who have been educating England. The engineer is always thinking of utility, of the value of time, of the fact that a man has only one life in which to do what good it is possible for him to do. So he reads novels and poetry and history; he enjoys painting and music; he travels and sees other people, other nations and their monuments. He cultivates and exercises the whole of his mental and emotional machinery so that he may become more perfect as a student of what Goethe called "the living mantle of God."

Everybody speaks of how the engineer has created what is called modern civilisation, has given luxuries of all kinds to the poorest people, has provided engines to do all the slave labour of the world, has given leisure and freedom from drudgery, and chances of refinement and high thought and high emotion to thousands instead of units. But few seem to see that the engineer is educating the imagination and poetic faculty of England. Every unit of the population is becoming familiar with scientific ideas, for he can hardly take a step without becoming acquainted with romantic steam engines and electromotors, with telegraphs and telephones and steamships, with drainage and waterworks, with railways, electric tramways and motor-cars. Every shop window is filled with the products of engineering enterprise. It is getting to be rather difficult for people to have any belief in evil spirits and witchcraft, and this is probably the most enormous intellectual stride that the great body of the human race has ever made in any half-century. It has been made in spite of the persistent opposition of Oxford.

It is due to Oxford that the interest taken in natural science by the richer classes, by men of expensive education, does not seem to be much greater now than it was thirty years ago. Some of them are called scientific if they go to hear lectures illustrated with fireworks, or if they assume as their eyes glance over a quasi-scientific article in a magazine that they are taking an interest in science. But among the less rich classes, the people who work with their brains, there is an interest now in science which is increasing in amount by the compound interest law. This new interest is recognised in the fine idea of Sir Norman Lockyer, so well talked about this summer, to form a great British Guild of Science the members of which might include almost every adult man or woman of brains in our Empire. His object is to organise the efforts now being made everywhere to interest people in science, to develop education in scientific method in every school in the country. I feel sure that this Guild will some time be formed successfully, and that it will do enormous service to the world. Its being successful in our own time depends mainly, I think, on the energy and persistence of Sir Norman Lockyer himself, and he certainly is an energetic man. May I ask if Oxford means, in her place of fancied security, merely to look on at great scientific movements? Or may it even be that she will use her autocratic authority to put all these movements down? Will she, in her pride, champion another lost cause? Or has she a sufficient number of young able men rich in the sort of enthusiasm possessed by William of Waynflete or William of Wykeham, by the pupils of Grocyn who did not lecture to Erasmus, or of Colet, the Dean of Eastminster. Just think of it you Oxford men, you who have entered on such an enormous heritage, you who have been supposed to stand for centuries at the head of the intellect of England. Are you now going to stand aside or are you going to oppose the greatest intellectual movement that has ever taken place in this world—or are you going to take your natural places in the foremost files of time?

If Oxford taught science through a student's own research, if Oxford gave a broad general culture suitable for all sorts of men of all sorts of minds, there is hardly any middle class man in England who would not be glad to send his son to Oxford. Even now the prestige of Oxford and the social advantages that it offers overweigh in the mind of many a parent all the intellectual disadvantages.

A man must be very impudent or very bold, or he must have much of the martyr in him, to criticise corporations like those which exist in Oxford. He must feel his cause to be infinitely right, because Oxford men have always been famous for their command of rhetorical weapons. There is hardly a man worthy the name of scholar in Oxford who has not a better command of such weapons than I. Think of the time when Oxford had fallen from her high estate in scholarship, so that Boyle and Atterbury had the same sort of ignorance of Greek which Oxford men now have of natural science; yet were these impostors so clever that they set all the world laughing at Bentley, the greatest scholar of a hundred years. Am I to be the fresh victim of the Bull of Phalaris?

Call it impudence if you please, but Oxford ought to be told what some outsiders think in this matter. She that represents all that is best in England, does indeed in some respects represent what is worst. Every young Oxford man is like a knight who sees only how beautiful is the lady whose colour he wears, and he forgets that the lovely body does not always cover the soul of Una; sometimes it hides the evil witch Duessa.

I do not address average men. I speak to those clever young men whose names are known now only in Oxford, whose names will in the future be carried on trumpet blasts over the world and for long time to come. Surely you aim at the study of those great eternal truths about man and nature which are hidden from the common view by prejudices; and surely you know that Oxford prejudices, however consoling they may be to your self-respect, however secure they keep you now from adverse criticism, are after all mere formulas and of only limited application, both in time and place.

You will say that I also have my prejudices, which urge me to ask if you wish for ever to look at man and nature through Greek spectacles. Well, I certainly cannot worship at Greek shrines. If Jowett's translation is the real Plato I can see none of the infinite depth of thought that my friends rave about; he seems to me pretentious and shallow; and when Aristotle speaks about things of which I happen to have some special knowledge, he seems to me so unscientific as to be maudlin. Macaulay somewhere says that the account by Thucydides of the retreat of the Athenians from Syracuse is the most affecting episode in history. Well, I have a great respect for Macaulay, and I have tried to cultivate a love for the people of the city of the Violet Crown, but I know some crimson patches of Macaulay's own which seem to me to be to Thucydides what Swinburne is to Shenstone. What is a fair man to say when he hears his friends talk of the greatness of Sophocles and Euripides and Aristophanes in the original, if he knows that these friends never read Shakespeare or Jane Austen or Goldsmith or Dickens? I feel ungrateful as I speak, for I have enjoyed the reading of Bohn's "Odyssey" and many another translation from the ancients as much as anything modern. Yet I cannot help acknowledging a suspicion that this worship of Greek is like one's fondness for the rhymes, often rubbishy rhymes, that associate themselves with our infancy and boyhood, or like Johnson's belief that his wife was amiable and beautiful. Have I, therefore, prejudices against Greek which prevent my seeing things from an Oxford point of view? I think not. At all events I can respect it, for I know that the other point of view has been held by some of the greatest Englishmen, and this alone is sufficient to give me diffidence. But whatever diffidence a man may feel in the expression of his opinion, he is sometimes compelled to put it aside. Not once, but many times in preparing this address upon Iceland and its snakes have I felt how stupid I was to undertake it, but it was too late to withdraw.

You will say that I, a man of little culture, am very poorly qualified to speak of reform to cultured Oxford men. Do you think that Jonah was particularly cultured when he was called upon to urge reform upon the rich, the intellectual, the high descended people of Nineveh? I do not speak to conscious Oxford. It is something altogether subconscious in a human being or in an institution to which we really speak when we expect reform. It is to subconscious Oxford that I speak, that dumb unconscious soul which has, on the whole, guided her rightly through the centuries in spite of all the visible long-continued eruptions of the flesh. Many colleges have for generations in the past been given up to eating and drinking and sensuality in general. Jealous quarrelling has ruled in her common rooms. Poor thin scholarship has often had unworthy victory. But the heart of England is beating in Oxford, and on the whole it is a very sound heart.

Now it seems to me—a rank outsider—that Oxford is cursed among universities in one very important particular. There has in the past been only one kind of real study here. Whatever was studied in Athens or Alexandria to the end of the second century A.D., that has been open to you, that has been a medium of mental training. But those subjects in which Germany has made her mark, theology, law, history, Bible criticism and others, these are denied you.

Who was it who first pointed out how England differs from France in one important particular? The French Revolution has made such a complete severance of the modern from the old French system that a French philosopher can discuss French history as if it were of another planet. When he speaks of the old provincial Parliaments or the edicts of St. Louis, his prejudices and interests interfere in no way with his reasoning. When he discusses the present Concordat or the *Coup d'État* of Napoleon, he makes no reference to the times of Philip Augustus or Louis XIV. But in England it is quite different. When the lunacy regency in the time of George III. was being discussed in Parliament, all the precedents long before the time of Henry VI., even back to the time of Edward II., had the force of legal documents. The Parliament and ministers of Charles I. both appealed to English history, and both found support for their very divergent views, and so English history has to be read and written with the bias of modern political party spirit. In the same way the student cannot touch the questions of theology or law without considering them as party questions. A subject which can only be approached by a student with prejudices evoked by the party politics of his own day is distinctly not a subject through which university culture is possible; I mean that it cannot be studied scientifically. Theology presently becomes mere dogma, and degenerates into credulity as the glory of the church is more important than truth. Thus it is that the scientific students at Oxford have confined themselves to the study of eight or nine old books. Never, perhaps, has there been so wonderful a phenomenon as this, the cleverest men of a nation devoting themselves for centuries to one narrow stream of erudition, making Greek literature and Greek philosophy phosphoresce in the most brilliant manner. But it is too narrow, this stream, and the laws of the game are too technical, too artificial. Consequently, every now and again something like the fidgets, the desire for something real to think about, seizes upon the Oxford community; it throws itself into politics or tractarian movements, it is strongly conservative or strongly liberal, it is high or broad or low, and, after a splendid display of energy, the fever works itself out, and there is a gradual return to the older learning after a time of unintellectual laziness. In these times of fever, as in the time of the Tracts, real study falls to its lowest ebb, because truth of any kind has ceased to be an object of worship. If I am right, then it is the leanness of the studies which are really scientific which causes these great alternations, these periods of degradation, these times of easy conscience when that freedom which is the glory of Oxford degenerates into licence. You know quite well that there must be such degeneration unless men have healthy, delightful work to do, and there is a healthy public opinion to be feared or welcomed.

Such attacks as those on the fair-minded Gibbon and examples such as that of the very much prejudiced Froude show how difficult it is for any Englishman to make a scientific study of English history, or English law, or English, or, indeed, any kind of Christian theology. Indeed, in the study of mental and moral philosophy of the *a priori* kind, according to any school from that of Socrates to that of Kant, it is difficult for an Englishman to keep clear of dogmatic theology and partisanship.

But the great world of natural science remains, the region in which no attention whatsoever need be paid to sacred books, to dogma, to authority, the region in which the mind feels no fetters, where no kind of individuality is a crime, a world of promise in which the first pioneers have already in a short time found great stores of wealth on the mere surface of the ground, a world which seems infinite in its possibilities. It is only in this free atmosphere that the mental constitution will become healthy enough to be able to combat prejudice and the dogmatic microbe. Talk no more of man as if he were apart from nature. The mind, the consciousness, the soul of man and all his emotions are natural and to be studied by the deductive and experimental and inductive methods used by us in all parts of natural philosophy. Give up this mere absorption of other men's ideas, whether in old classics or in quarterly and monthly reviews, this collecting of ready-made opinions on all subjects whatsoever. Are you for ever to hang to the apron strings of the ancients? Is your manhood worth so little that you cannot exist without worshipping men who were creatures like yourselves? You speak of the reason of man as if it were an omnipotent thing. We speak of the spirit of God in man brooding over phenomena which seem chaotic until new light is evolved and you actually think that we are beggars living upon scraps of wisdom dropped from your tables. When you insist upon your classical tests you spoil our whole scheme of study, and you are merely acting as brigands, you are only taking that sort of *advantage* which all mean people take when they have official positions.

It is not learning that is important. A university is to create men, men of original thought, men of character, men of resource, men fond of reading. And you men of the university as distinct from the colleges—if you really can invent some examination which will select the men of thought, do so, and use it, but for my part I do not think this business of selection one for

any kind of machinery that ever yet was invented. There is too much of the ludicrousness of Teufelsdrüch's iron king about all schemes of examination that ever I have known, and there is too much of the draper's assistant style of work about your boards and committees. If you have any really important piece of work to do, give it to some one *man* to do, and ask people to discuss it at a public meeting; but this committee kind of pretence of work is getting to be ridiculous. You are certainly wasting the time of the few good men and giving easy consciences to all the other men who attend these boards.

I hold a brief for the average man usually said to be stupid, and yet I have been speaking of scholars, the rulers of the university, the men to whom younger men look up with worship. This is because there can be no real teaching unless some of these higher men are really great students themselves. Never did men have as good a chance of education for themselves as the fellows of the rich Oxford colleges; never had men such a chance of merely marking time and pretending to educate themselves.

About seventy years ago teaching began to become the very valuable monopoly of the college tutors. This could hurt, but could not destroy, the effect of college life in producing liberal culture. The college don ceased to be a student, he tried to teach many different subjects much in the style of the fourth form master in schools; he prepared men for Responsions, which is really a sort of belated matriculation examination; clever men may still pay him fees, but for them there is only harm in attending his classes. Hence it is that for thirty years you have been returning to the ancient practice, and the number of university professors, of lecture halls and laboratories is slowly growing. Surely this is the direction of true reform. Is it not possible to get each rich college to establish two or three great schools in which only two or three subjects may be studied by men through their own research, commanded by men of the highest talent and initiative, who are free to teach as they please and to examine as they please? But what chance is there of this or any reform? We have reached a time when the good men are discouraged and the bad men are triumphant. The powers of Arimanes set themselves against the powers of Oromasdes, disputing reform, and there have been many signs during the last fifteen years that the powers of darkness, those opposed to science, have organised themselves more scientifically than the powers of light. They have determined that in the future no change shall be made in the character of Oxford studies.[1] They do their best to make past reforms operative only for evil. As for the reformers, their conception of a university is of one in which there are so many literary and scientific subjects taught that every student can obtain, through the study of few or many of them, the most perfect training of which his mind is capable. Some of us have the belief that the average mind is capable, by training, of becoming immeasurably richer than even a few exceptionally great minds have ever been.

By the study of a subject I mean not merely listening to lectures, not merely using books, not merely a student's own research, or discussion with other men whose courses of study may be the same or not the same, but all this and much more, the most important after research being the worshipful study of great men whom the student is privileged to meet and possibly to work with. I mean also that a youth ought to have had a previous training fitting him for university study. There are few boys who might not be well trained at the age of fifteen; in my opinion ninety per cent. of Oxford undergraduates are at present quite unfit for any kind of university study.

I now come to a question in which I stand alone, and I beg your patience. My best friends seem unable to criticise me, for they find it impossible to get to my point of view. What ought to be the nature of the matriculation examination? I wish I had half an hour in which to try to convince you that its sole object is to test whether a student is likely to benefit by *any* of the university courses of study. Surely this was the mediæval idea; the one compulsory subject was Latin, because all the literature known to students and teachers was in Latin; all lectures were delivered in Latin; all teaching was in Latin. Consequently, in some Oxford colleges a man was fined if he spoke in any other tongue. Surely it was a good time when all learned men in the world spoke the same language. Then came the time when there was still no English literature, and not only was the best literature in Greek, but Greek was the only approach to natural knowledge, so Greek also was compulsory, and so it has remained to this day—to this day, when English literature is of greater worth than any ancient or, indeed, any other modern literature, when all teaching, all lectures are given in English, and when our English knowledge of natural science is not only infinitely greater than anything possessed by the ancients, but it enables us to say that the ancients were hopelessly wrong, when nobody except the official university orator or some traveller ignorant of the language of a foreign country speaks Latin, and speaks rather the Latin of Stratford-atte-Bow than the Latin of Rome! Three hundred years ago the rule was reasonable and necessary, but to insist on its observance now, when it is stupid and unnecessary, seems to me quite unscientific.[1]

I would therefore make a knowledge of Latin or of Greek compulsory only on students of certain subjects, and the professor ought to impose the condition, not the university. Again, students of certain other subjects ought to be supposed to know one or more modern foreign languages, and, indeed, it seems to me that the professor in each subject has a right to insist, if he pleases, on his students having certain special knowledge before they enter on the study with him. I would give him this right because I want him to have perfect freedom. But to enter the university, merely to matriculate, surely the compulsory subjects ought to be as few as possible. It seems to me that the most important thing is that every student should have had an early education through his own language, English; should be able to write an account in English of anything he had seen; should have some acquaintance with what are called English subjects, such as geography and history and the principles of natural science, and the power to make simple computations. All the teaching is to be in English, all his companions speak English; there are good English books on all subjects, there are English translations of all the good books that have been written in foreign languages.

I am afraid that no Oxford man can understand the following statement, which I make as a man of some experience, speaking with a full sense of responsibility. So abominable do I think *compulsory* Latin or Greek, or French or German, that I believe a board school to be a much better school than any other for a boy if he is fitting himself for any profession in which applied science is important.

I can understand why Tom Sawyer and his friends, when they started their gang of robbers, initiated them through passwords and a ritual. That was for "side." The gang did not consist of pirates or robbers; they were innocent young boys, and their passwords and ritual were the essence of the romance of the thing. This compulsory Latin and Greek for the average youth at Oxford seems to me merely grown up Tom Sawyerism, and it is allied in obvious ways to the worship of mumbo-jumbo. It used to be that the use of fur on clothes was reserved for the higher classes. At another time gentlemen only were allowed to wear swords. In China and Japan certain buttons and coloured dresses indicated certain rank. In our own time there are fashions of slang which distinguish the smart set of society. The survival of Latin and Greek as compulsory subjects is very much the same sort of thing. It

[1] Throughout this address my hands have been tied so that I may not make particular references. But suppose I were to provide money for the endowment of a valuable professorship of some scientific subject, do we not know what the Oxford authorities would do with it? They would appoint as professor a man who had never done any scientific work, who can never be expected to do any scientific work, who never wants to do any scientific work, and whose highest ambition will be to act zealously as the bursar of his college!

[1] It is very interesting to me to note that on the very day when I wrote this sentence, after dinner, amusing myself and not in any way for the purposes of this address, I happened to be reading the "Life of Plutarch" written by the Langhornes, and these words caught my eye:—"Another principal advantage, which the ancient mode of the Greek education gave its pupils, was their early access to every branch of philosophical learning. They did not, like us, employ their youth in the acquisition of words; they were engaged in pursuits of a higher nature; in acquiring the knowledge of *things* They did not, like us, spend seven or ten years of scholastic labour in making a general acquaintance with two dead languages. These years were employed in the study of *nature*, and in gaining the elements of philosophical knowledge from her original economy and laws."

has no more to do with education than the two hind buttons on our coats or the wigs of our judges have to do with convenience. These three kinds of school training—in one's own language and literature, in the principles of natural science, in common-sense computation—are absent from all public schools at the present time; it seems mere impudence in me to make them the only compulsory forms of training for men who are to enter a university. Until this is done, I think that most of the endowment of science scholarships is quite wasted.

I agreed to give this address because I knew that Sir Norman Lockyer intended in his British Association address to propose a very large Government endowment of the universities. At first sight his suggestion that 24 millions of pounds should be devoted to this purpose seemed ridiculous, but careful study has brought many thoughtful business men round to the idea; it is not utopian, it has actually a good chance of being carried out.

I saw, as many of my friends see, that the one thing which may wreck the project is the reputation of Oxford. Our rulers who have to grant the money know of universities only through their knowledge of Oxford. It is hardly possible for them to understand what we mean by a true university, which would give to every student real breadth of culture, real mental training. They may be brought to see it if Oxford men are in earnest in trying to develop Oxford on scientific as opposed to unscientific and ill-regulated lines; if the powers of light organise themselves as scientifically as the powers of darkness are organised. But there are certain intellectual movements going on in our nation which may force our rulers to grant the money; Oxford seems to know little about them and to care less; they seem to her to be merely a new untying of the bags of Æolus; it is my belief that if Oxford knew more about them she would build an altar to the goddess of *Fear* and offer sacrifices upon it, yea, burnt offerings of some of her best-loved possessions.

Oxford has a well earned prestige and still attracts all young men of intellect, but these new intellectual forces may quite quickly destroy the reputation which has been built up during centuries. For example, we have a new kind of secondary school, of which some five hundred have been established all over the country in the last few years. I myself think the science schools, scheduled as A schools, to be much the best of them, but the most numerous of them are the B schools, in which there is some natural science taught through boys' own research, but the time devoted to it is not much more than what is sufficient to enable us to say that in these schools boys are greatly emancipated from the old Oxford limitations. These schools before their emancipation sent many a fine scholar and mathematician to Oxford and Cambridge. They still rank below the great public schools. What is aimed at is an education which may suit any kind of boy, a real liberal education such as the older schools know nothing of. It is even hoped that shortly somebody in one of these schools will discover how English may be taught to English boys. All these, like the science schools, are due to the work of Sir William Abney. Now the boys of these schools, when they leave, wish to complete their education on the lines on which they have been working so far; are these exceptionally able students to be told that Oxford cannot complete that education? Few people seem to be aware that the growth of these schools indicates a great revolution; anybody who notes their rapid growth must feel sure that in a few years no secondary schools, except a few of the public schools, will continue to work under Oxford traditions. It ought to be noticed that unless boys in future are prepared on these new lines, it is not worth their while to enter Woolwich or Sandhurst, or the Admiralty colleges, because they will not be able to follow the higher instruction there given, and must drop out of the race for commissions. It is evident that the days of special army and other classes in schools are numbered. If Oxford by holding aloof from this movement ceases to influence the majority of the secondary schools, it will lose its influence over a great body of people of the middle class.

I have already mentioned another great movement from which Oxford is holding aloof, the movement for technical education the basis of which is the sort of study trifled with, feared, and hated at Oxford, natural science. It has spread from the very lower classes to the lower middle classes, and better and better buildings and apparatus, and better paid teachers indicate the higher and higher social position of the pupils of the technical schools. A few Oxford men have greatly helped in starting both of these great movements, and Oxford as a whole, if she cared, might be in a position to take a leading part in them. She has an influence now due to the easily interpreted fact that Oxford men occupy many of the higher posts connected with both of them.

It is not only that Oxford keeps aloof from technical education, but she keeps aloof from the very much greater thing of which this movement is only a symptom, namely, the phenomenon that trade and manufacture are no longer left to themselves as they used to be; they are being organised on scientific lines in all countries. She has always ostentatiously held herself aloof from manufactures and commerce. It is almost incomprehensible that a university aiming at breadth of culture should scorn those things which keep England in her high position, give value to the real estate on which Oxford's own revenues depend, and differentiate Oxford from Beyrout. I feel sure that this attitude ought to be quite carefully veiled if Oxford is to have such a share in the 24 millions as her prestige would otherwise warrant her demanding.

The truest stories about man are the fairy stories; they are true of all times, of all races of men, and the truest fairy story is that which tells how men who look back and not forward are turned into lumps of rock or pillars of salt.

I want the forces of light at Oxford to organise themselves to teach Oxford how she may become worthy to maintain the reputation which she earned so well in the past. Her great glory is *not* in her defence of lost causes as many men think. Was the movement started by Roger Bacon a bad cause? Is it a lost cause? Has the movement started by Grocyn and Colet become a lost cause? Has the movement started by those Oxford men who founded the Royal Society become a lost cause? Are the names of Wycliffe and Wesley forgotten? Have the reforms started by Stanley, Jowett and Pattison in our own times become lost causes? Not yet! The influence of Oxford over intellectual England used to be supreme, it is still enormous; it rests with the young Oxford men of the present day who know something of history tc decide whether this influence may or may not become a cause lost beyond all chance of finding again.

A NEW GERMAN BOTANICAL SOCIETY.[1]

THE publication of the first report of the meeting in Berlin of the Society of Germans interested in the Study of Systematic Botany and Plant Geography calls for more than passing notice. The society owes its creation to a well-founded cause, and is indicative of a response to that spirit of colonisation which has shown itself in Germany more and more during the past thirty years. In the first half of the nineteenth century the British Government, merchants and others were calling out for information as to the character of the flora of our colonies, and, as a result, British botanists were mainly engaged in the study of systematic botany, while the German botanists were occupied in the investigation of the structure, physiology and pathology of the individual plant, with results in each case well known to all serious students of botany.

The German systematists do not take a prominent place at the meetings of the German Association for the Advancement of Science, and though in their new society they propose cooperation, if possible, with it and with the Deutsche Botanische Gesellschaft, they seem to feel the necessity of a separate society to meet the requirements of their own branch of botanical study, which, during the last twenty years, has made enormous strides. Explorers have been sent out into all parts of the globe, and not simply to the German colonies. Listening to the papers from day to day it seemed that, so far as the conference was concerned, the

[1] Bericht ü. d. Erste Zusammenkunft der freien Vereinigung der systematischen Botaniker u. Pflanzengeographen zu Berlin. Pp. 83. (Leipzig: W. Engelmann, 1903.)

German flora might have been almost non-existent, so wide is the field covered nowadays by German investigators. Nor is this outlook due simply to the desire to know more of the economic value of their colonial floras. The more complete our knowledge the surer will the foundation be laid for that natural system of classification which so far has been most nearly reached in Engler's "Pflanzenfamilien." These two objects, increase of knowledge of the economic value of particular floras, and the reduction of the imperfection of record of the world's flora, in time and space, were kept prominently before the conference. It was refreshing to an Englishman to hear the various readers of papers acknowledge the work of the Hookers, Bentham, and others. A third object in starting the society was well carried out—to bring together the systematists in Germany, &c., for semi-scientific and semi-social intercourse.

Each evening members, accompanied in some cases by ladies, met in a restaurant for dinner, the most enjoyable of these functions being the one in Potsdam, ending a long day's excursion in the forest on the banks of the Wann. See. After an explanation of the plans for the new herbarium, &c., to replace the overcrowded botanical museum and the old gardens in the city, a visit was paid to the new gardens in the suburb of Dahlen. Here, as in the old museum, it was interesting to notice not only the grasp the director, Dr. Engler, had of everything, but also the way in which he brought forward the officers of the various departments, and left them to tell their story. Appreciation of the importance of the protection and preservation of special plant habitats or of special individual plants, and also of beautiful scenery, was illustrated by a paper by Dr. Conwentz, who for three years past has devoted his time, at the Government's request, to the study of the question, and is now engaged in the preparation of an illustrated elaborate report. The next meeting of the Society will be held in Stuttgart on August 4–7, 1904, and should be borne in mind by British botanists; the subscription for membership is only three shillings.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

Mr. R. H. Yapp, of Cambridge, has been appointed professor of botany in the University College of Aberystwyth in succession to Prof. J. H. Salter.

Mr. Hugh Davies has been appointed head of the building trades department of the Northern Polytechnic Institute in succession to Mr. H. W. Richards, who was recently made principal of the London County Council School of Building at Brixton.

The debt of 5000*l.* in connection with the University College, Bristol, has now been entirely liquidated. Sir William H. Wills, Bart., and Sir Frederick Wills, Bart., M.P., each contributed 1000*l.* towards the amount required, and a further sum of 500*l.* has been given by the managers of the Exhibition of Welsh Industries recently held in Bristol.

The governing body of the South-western Polytechnic, Chelsea, has accepted with very great regret the resignation of the principal, Mr. Herbert Tomlinson, F.R.S. At a meeting held on December 16, the following resolution was passed:—"That the governing body hereby desire to record their cordial appreciation of the admirable work that Mr. Tomlinson as the first principal has accomplished in organising and developing the institute in all its branches."

At the Royal United Service Institution Mr. C. E. Stromeyer read a paper on short service training for reserve officers. It contained a sketch of the German "Einjährig Freiwilliger" system, which, according to the author's views, supplements the ordinary school and university studies by a good insight into the human nature of the German workman by bringing him and the one year volunteer into close contact while serving together in the ranks. German technical students are therefore fit at an early age for the posts of submanagers in industrial undertakings, whereas English lads fresh from technical colleges are not trusted to deal with workmen. The author suggests that the War Office should encourage young men from public schools and from universities to join the army for a short period.

SOCIETIES AND ACADEMIES.

Paris.

Academy of Sciences, December 21.—M. Albert Gaudry in the chair.—After the delivery of the annual presidential address, the prizes offered for the year 1903 were awarded. In geometry, the Francœur prize to M. Émile **Lemoine** for the whole of his work in geometry; the Poncelet prize to Prof. M. **Hilbert,** University of Göttingen, for his works on the principles of geometry. In mechanics, the extraordinary prize of 6000 francs was divided as follows:—one-half to M. **Maugas,** chief engineer in the navy, for his researches on the stability of battleships and his works on submarine navigation; the other half was divided in equal parts between Lieutenants **Jehenne, Gaillard,** and **Germain,** the first for his work in the application of wireless telegraphy to the navy, the other two for the improvements they have carried out in apparatus intended for the transmission of orders or signals during a battle. The Montyon prize was awarded to Prof. **Bodin** for designing and executing a new system of cantilever at the Viaur viaduct; the Plumey prize to Prof. **Marchis** for the free courses of instruction in applied mechanics organised by him, and more especially for his lessons on steam and heat engines. The Fourneyron prize was not awarded. In astronomy, the Pierre Guzman prize was not awarded; the Lalande prize was awarded to Prof. **Campbell,** of the Lick Observatory, for his investigations in stellar spectroscopy and astronomical physics; the Valz prize to M. **Borrelly** for his discoveries of comets; and the G. de Pontécoulant prize, intended to encourage researches in celestial mechanics, to M H. **Andoyer** for his memoirs on the theory of the moon and that of the small planets. In physics, the Hébert prize was awarded to Dr. E. **Goldstein,** of the Berlin Observatory, for his investigations, during thirty years, of electric discharges through rarefied gases and the discovery of a particular kind of radiation; the Hughes prize fell to M. Pierre **Picard** for the improvements effected in telegraphy, improvements which have increased the rapidity of transmission in submarine cables; the Gaston Planté prize to M. **Hospitalier** for his ondograph. In statistics, the Montyon prize was not awarded, though MM. **Loncq,** de Montessus **de Ballore,** and **Razous** each received an honourable mention. In chemistry, the Jecker prize was given to M. L. **Bouveault** for his numerous researches in organic chemistry during the last seventeen years. The La Caze prize fell to M. A. **Guntz** for his thermochemical investigations on the compounds of fluorine with metalloids and with metals. In mineralogy and geology the Delesse prize is awarded to M. Emmanuel **de Margerie,** joint author with General de la Noë of "Les Formes du Terrain," and translator into French of "La Face de la Terre," by Prof. Suess, of Vienna. In physical geography, M. R. P. **Colin** received the Gay prize for the determination of numerous geographical positions in Madagascar. In botany, the grand prize of the physical sciences was not awarded, nor were the Bordin and Desmazières prizes. M. **Maire** was accorded the Montagne prize for his delicate researches in connection with the Basidiomycetes. The Thore prize was awarded to M. **de Istvanffi** for his work upon the diseases of the vine known as "white" or "red" rot. In rural economy the Bigot de Morogues prize fell to M. Eugène **Rister** for his well-known "Géologie agricole." In anatomy and zoology, M. R. **Fourtau** is accorded the Savigny prize for his memoirs on Egyptian stratigraphy and other palæontological subjects, and M. **Krempf** receives an honourable mention. The Countess **Maria von Linden** gained the Da Gama Machado prize for two memoirs on the development of the colours in the wings of butterflies. In medicine and surgery, Montyon prizes are awarded to M. **Dominici** for his memoirs on the normal condition of certain organs, and also when infected; to

M. Jean **Camus** for a work entitled "Les Hémoglobinuries"; to M. Robert **Lœwy** for his method of peritoneal grafting. Honourable mention was also made of the contributions of MM. **Nicolle** and **Remlinger, Nobecourt, Merklen** and **Sevin**, Ch. **Monod** and J. **Vanverts.** The Barbier prize is divided between MM. **Anthony** and **Glover**, the work of the former being in connection with the sternum, and that of the latter a new therapeutic method based on the application of a warm spray of non-volatile liquid. The arrears of the Bréant prize were divided between M. E. **Chambon** for his memoir "L'Institut de vaccine animale, son histoire depuis sa fondation en 1864," and Dr. **Borrel** for his papers on the parasitic theory of cancer. The Godard prize was awarded to Drs. N. **Hallé** and B. **Mötz** for their contributions to the pathological anatomy of the bladder. Dr. J. B. **Hillairet** received an honourable mention. The Lallemand prize was divided between Mlle. **Joteyko** and MM. **Garnier** and **Cololiau**, and Dr. Giuseppe **Pagano** was honourably mentioned. Dr. Paul **Godin** received the Larrey prize for his contribution on military hygiene, and M. G.-H. **Lemoine** and Dr. Jules **Régnault** were honourably mentioned. Dr. F. **Battesti** was accorded the Bellion prize, while Dr. R. **Glatard** was mentioned very honourably. The arrears of the Mège prize fell to Dr. A. **Monprofit** for his work "Chirurgie des ovaires et des trompes." Dr. Alfred **Fournier** was awarded the Chaussier prize for his important contributions to medical and social science. In physiology, the Montyon prize was divided between M. **Arthus** for his researches on the coagulation of the blood, and M. V. **Henri** for his work on the action of diastases. The work of M. **Bounhiol** on the respiration of annelids receives particular mention. The Philipeaux prize was accorded to M. Lucien **Daniel** for his investigations as to the nature of grafts and grafting. Prof. Chas. **Richet** received the La Caze prize for his numerous contributions to physiology. Dr. J. **Denoyès** was awarded the Pourat prize for his treatment of the subject proposed, viz. the action of high frequency currents on the phenomena of life. The essays of MM. **Regnier** and **Bruhat** were honourably mentioned. Prof. H.-G. **Zeuthen**, of Copenhagen, received the Binoux prize for his studies on the history of the sciences. Of the general prizes, the Lavoisier medal was awarded to Prof. Carl **Graebe**, of Geneva, for his work in organic chemistry. Berthelot medals were awarded to Prof. **Graebe** and to MM. **Bouveault, Guntz, Chavanne,** Victor **Henri, Arthus,** and **Capelle.** The Montyon prize (unhealthy trades) was not awarded, but an honourable mention was accorded to M. Edouard **Capelle** for his work on lighting and heating by acetylene, the Wilde prize to M. **Collet** for his determinations of the intensity of gravity, the Tchihatchef prize to Dr. Sven **Hedin** for his explorations in Asia, the Cuvier prize to M. Eugène **Simon** for his "Histoire naturelle des Araignées," the Parkin prize to MM. **Lacroix** and **Giraud** for their investigations on the recent eruptions of Martinique, the Petit D'Ormoy prize (mathematical sciences) to M. Jacques **Hadamard**, the Petit D'Ormoy prize (natural sciences) to M. Bernard **Renault,** the Boileau prize to M. Marius-Georges **Grandjean**, the Estrade-Delcros prize to M. Léon Teisserenc **de Bort** for his fourteen years' work in meteorology, the Cahours prize between MM. **Marquis** and **Chavanne,** the Saintour prize to M. Marcel **Brillouin** for his works on mathematical physics, the Trémont prize to M. Charles **Frémont** for his method of determining the limit of elasticity of metals employed in the arts, the Gegner prize to M. Jean-Henri **Fabre** for his investigations in biological science, the Lannelongue prize to Mme. Ve **Nepveu,** the prize founded by Mme. la Marquise de Laplace to M. **Rémy** (Louis-Gabriel), and that founded by M. Félix Rivot is divided between MM. **Rémy, Breynaert, Gillier,** and **Bouteloup.**

GÖTTINGEN.

Royal Society of Sciences.—The *Nachrichten* (physico-mathematical section), part v., 1903, contains the following memoirs communicated to the Society:—

July 25.—K. **Schwarzschild**: Electrodynamics, iii. On the motion of the electron. A. **Schœnflies** and F. **Pockels**: Report on Plücker's scientific remains.

August 5.—P. **Furtwangler**: On the construction of the *Klassenkörper* for given algebraical domains, which contain the *l*th root of unity.

October 31.—F. **Bernstein**: On the *Klassenkörper* of an algebraical domain (second paper). L. **Heffter**: Proof of the Cauchy-Goursat integral theorem. R. **Schimmack**: On the axiomatic basis of vector-addition. C. **Runge**: On the electromagnetic mass of the electrons. R. **Fricke**: On the polygonal *continua* occurring in the theory of automorphous functions.

DIARY OF SOCIETIES.

THURSDAY, DECEMBER 31.

ROYAL INSTITUTION, at 3.—Extinct Animals: Prof. Ray Lankester, F.R.S.

FRIDAY, JANUARY 1.

GEOLOGISTS' ASSOCIATION, at 8.—The Jurassic Rocks of East Greenland: Dr. Victor Madsen, translated with additional observations by Miss Ethel G. Skeat.

SATURDAY, JANUARY 2.

ROYAL INSTITUTION, at 3.—Extinct Animals: Prof. Ray Lankester, F.R.S.

MONDAY, JANUARY 4.

SOCIETY OF CHEMICAL INDUSTRY, at 8.—On the Defects of Uncarburetted Water Gas as Fuel for Laboratory Use: Dr Chikashigé.—The Rapid Estimation of Mercury by means of Hypophosphorous Acid: B. F. Howard.—The Determination of Moisture in Nitro-glycerine Explosives: Arthur Marshall.

ARISTOTELIAN SOCIETY, at 8.—Prof. Sidgwick's Ethical Philosophy: Miss E. E. Constance Jones.

TUESDAY, JANUARY 5.

ROYAL INSTITUTION, at 3.—Extinct Animals: Prof. Ray Lankester, F.R.S.

WEDNESDAY, JANUARY 6.

SOCIETY OF ARTS, at 5.—Navigation of the Air (Juvenile Lecture): Eric S. Bruce.

GEOLOGICAL SOCIETY, at 8.—On a Palæolithic Floor at Prah Sands in Cornwall: Clement Reid, F.R.S., and Mrs. Clement Reid.—Implementiferous Sections at Wolvercote (Oxfordshire): Alexander M. Bell.

THURSDAY, JANUARY 7.

RÖNTGEN SOCIETY, at 8.30.—The Revelations of Radium: Dr. G. B. Batten.

ROYAL INSTITUTION, at 3.—Extinct Animals: Prof. Ray Lankester, F.R.S.

FRIDAY, JANUARY 8.

ROYAL ASTRONOMICAL SOCIETY, at 5.

SATURDAY, JANUARY 9.

ROYAL INSTITUTION, at 3.—Extinct Animals: Prof. Ray Lankester, F.R.S.

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THURSDAY, JANUARY 7, 1904.

THE CRITICAL STATE.

Le Point critique des Corps purs. Pp. viii + 255. (Paris: C. Naud, 1904.)

OF late numerous attacks have been made on the commonly accepted theories relating to the conditions which obtain at the critical temperature of pure substances, and though the assailants may have received little support, or even attention, from the mass of their physical brethren, it is time that certain questions relating to the critical state were more definitely settled.

In the opening chapter of this work the author discusses the general case of the evaporation of liquids at temperatures up to their critical point, leading up to the statement, which opens the second chapter, that the theories of Andrews and Van der Waals are insufficient to explain the observed phenomena. For instance, Battelli has attempted to prove that the temperature at which the meniscus disappears in a sealed tube containing alcohol is a function of the concentration of the alcohol in the tube. The experimental results are quoted; they are as follows:—

Date of experiment	Mean density of liquid and vapour in sealed tube	Observed critical temperature
1891	0·3195	236·39
1892	0·3434	237·02
1891	0·3448	236·26
1891	0·3839	235·66
1891	0·3889	235·94
1892	0·4000	236·43

Similar results were obtained in the case of ether, but it is difficult to see how they may be fairly interpreted as supporting the author's views. A very small quantity of impurity would be quite sufficient to account for these abnormal, but by no means concordant results.

The experiments of Galitzin are next quoted to prove that the temperature of disappearance and reappearance of the meniscus is dependent not only on the mean density of the substance in the tube, but also on the dimensions of the latter. Sealed tubes containing ether were heated slowly to 200° C., maintained at that temperature for twenty minutes, and then allowed to cool slowly. A maximum difference of 0.9° C. between the temperatures at which the meniscus disappeared and reappeared again was observed, and as no evidence to the contrary is forthcoming, there is no reason for assuming that the temperature difference is not due to the lagging of the temperature of the liquid in the capillary tube after that of the bath. It is further remarked that, if one repeatedly heats and cools such a tube, the meniscus tends to reappear after each operation at a lower point in the tube. That this is not observed when the tube is shaken is highly significant.

In the succeeding chapters the various methods which have been applied to the determination of the critical constants are described and criticised, theoretical questions being discussed as they occur. Opening with an account of Andrews's experiments, and the development of his method at the hands of Ramsay, Young, and others, the author leads up to a discussion on the application of the modified gas equation to the calculation of the critical constants from the data for the isothermals. As an example, he takes Sarrau's attempt to employ Clausius's equation to calculate the critical constants of hydrogen from Amagat's determinations of the compressibility of that gas. The results are, of course, wide of the mark, but it is interesting to note that Wroblewski, who investigated the isothermals of hydrogen between +100° C. and −182° C., obtained, by means of a similar equation, a very fair approximation of their values.

In chapter vi. the author discusses the effect of the gravity of the substance under investigation on the density at different levels in the capillary tube. Here again our knowledge of the subject is very scanty, and experimental evidence is required to support the theoretical results of Gouy and others who have treated the subject mathematically.

Particularly interesting accounts of special series of researches are given in the succeeding chapters. Olszewski's determination of the critical pressure of ethylene, oxygen, and hydrogen is described in detail, and the theory of the method, which is not dealt with in the original paper, is explained by means of a diagram. This piece of work is important, as it involves a new method for the determination of critical pressures, and gives us the only published experimental data for the critical pressure of hydrogen. Some of the methods described by the author as "élégantes mais pur précises" are interesting, as they furnish suggestions which may be applied to other problems. The behaviour of mixtures, which could not be entirely omitted from the work, is briefly discussed, and diagrams are given illustrating the graphical method of treating the results. A table of critical constants occupies several pages.

The final section of the book deals with the theories which have been put forward to account for the apparent irregularities in the behaviour of pure substances, and the deviation from the simple laws hitherto supposed to govern the phenomena which take place at the critical point. The existence of two kinds of molecules, gasogenic and liquidogenic, which persist in the vapour phase, was first suggested by de Heen, and has recently received support from Traube and others. As was long ago pointed out by Sir G. Stokes, de Heen's theory demands that the pressure of a saturated vapour of a pure substance, like that of a mixture, must be dependent on the relative masses of the liquid and vapour phases, and this is contrary to all experience. Modifications of this theory, involving an idea of a definite equilibrium dependent only on temperature between the two kinds of molecules, may be more easily tenable; but, as the author suggests, the existence of liquidogenic molecules, having only a transitory existence in the vapour phase, and dissociating slowly into gasogenic molecules, would account for most of the phenomena which have been observed.

There are two obvious sources of error in measure-

ments of the kind described in this work. In the first place the substances must be of a very high degree of purity, and as the author justly remarks, there is usually no evidence that this has been the case. In the second, the difficulties experienced in maintaining temperatures which do vary at a greater rate than 0.002° per minute are enormous, and in dealing with substances enclosed in thick-walled capillary tubes, the temperature difference might be in some cases of the same order as the observed abnormalities were the temperature less steady.

Whatever may be the fate of the new theories or the opinion as to the value of some of the experiments on which they are based, we are indebted to the author for collecting and arranging this mass of information, and for bringing the points at issue so clearly before the scientific world. M. W. T.

THE B.M. HAND-LIST OF BIRDS AND CATALOGUE OF EGGS.

A Hand-List of the Genera and Species of Birds. Vol. iv. By R. B. Sharpe. Pp. xii+391. (London: Printed by Order of the Trustees, 1903.)

Catalogue of the Collection of Birds' Eggs in the British Museum (Nat. Hist.) Vol. iii. By E. W. Oates and S. G. Reid. Pp. x+349; 10 plates. (London: Printed by Order of the Trustees, 1903.)

WHEN the publication of the valuable "Hand-List" was commenced, it was considered that the work would be completed in four volumes. The fourth volume is, however, before us, and the author's task is far from being ended. This, as stated in the preface by the director of the Museum, is due to the unexpectedly large amount of space occupied by the Passeres (or Passeriformes, as the author prefers to call them), the number of named species of which group has been largely augmented during the progress of the work. Accordingly, in order to keep the present one of moderate dimensions, it has been decided to complete the work in five, in place of four, volumes. The fifth and concluding volume, it is satisfactory to learn, is in a forward state, and will probably be issued shortly.

Our opinion of the high value of this work having been already expressed in our notices of the earlier volumes, it need not be repeated here, although we must again state that it would have been an improvement had the dates of publication of the generic names been introduced. We are, moreover, debarred from criticising the right of certain forms and groups to specific or generic rank, for the author in this instance has been bound to follow the arrangement adopted in the "Catalogues."

All that remains open to us in the way of criticism is in relation to geographical and topographical names, and even here there is not much with which to find fault. We venture to think, however, that the author uses the term "Himalayas" or "Himalaya Mountains" in somewhat too wide a sense. Possibly he may be justified in including Kashmir in the "Himalayas," although scarcely in the "Himalaya Mountains," but there is no justification for calling Ladak (p. 147) a part of that system. Then, again, on p. 149 we find Murree (Murri) described as being in the *eastern* Himalaya. The author's spelling of that name—as Murri—is, moreover, without justification. Many years ago the Indian Government decreed that the names of well-known places were to be spelt in the old-fashioned way. If this ruling be followed, Murree is the proper orthography; if, however, the Hunterian system be followed, it should be Mari; Dr. Sharpe's "Murri" is neither one system nor the other.

If the proof-reading had been done a little more carefully, certain discrepancies in the printing of names might also have been avoided. We should not have had, for instance, in one place Amur-land (p. 138) and in another Amurland (p. 339), or Somali Land (p. 12) and Somali-land (p. 293), or Szechuen (p. 8) and Sze-chuen (p. 322), or Damara Land (p. 22) and Damara-land (p. 331). Again, we believe that Gansu (p. 321) and Kansu (p. 323) are one and the same. Finally, we do not like the phrase (p. 259) "Arctic and Subarctic regions of both hemispheres," which, although no doubt etymologically correct, sounds somewhat ambiguous.

In regard to the third volume of the "Catalogue of Birds' Eggs," the most notable feature is its dual authorship, or, to be precise, that it is written by Mr. E. W. Oates, assisted by Captain Savile Reid. The explanation of this is to be found in the preface, where it is stated that, owing to the ill-health of Mr. Oates, it had been found necessary to entrust the completion of the work to other hands. In the case of this volume the MS. was left in a forward state by Mr. Oates, and has been revised, together with the proofs, by Captain Reid, who has also incorporated in the text references to recently acquired specimens.

The present volume commences with the parrots, and includes the whole of the so-called "picarian" birds, together with a considerable number of the passerines, that is to say, from the Pteroptochidæ and Formicariidæ to the bulbuls (Pycnonotidæ). From what has been written above, it is scarcely necessary to add that the plan followed in this volume is the same as in its predecessors. Now that a change of authorship has taken place, we may suggest that the value of the work would be decidedly increased if the characteristics of the eggs of the different families and genera were given in some detail in the volume yet to come. As it is, no regular rule seems to have been followed in this respect, and it is therefore quite impossible to gather of what value are egg-characters in classification.

The exquisite plates illustrating this volume are, like those in its predecessors, reproduced from sketches by Mr. H. Gronvöld. Although the number of the plates is somewhat less than in vol. ii., the number of eggs figured is (owing to their smaller size) much greater. It may be added that small eggs, like those figured in this volume, form much more attractive octavo plates than is the case with the larger ones depicted in the earlier volumes, and whichever of the two authors is responsible for the grouping of the specimens figured he is to be congratulated, from an artistic point of view, on the result. As a rule, eggs

which have not previously been figured are selected for illustration.

The total number of species catalogued in this volume is 907, and the number of eggs 8474; the latter are, however, very unevenly distributed among the various species, of many of which there is but a single egg in the collection. This is the case, for instance, with three out of the four species of "frog-mouths" catalogued, and likewise with many of the kingfishers, cuckoos, and humming-birds.

The collection is especially rich in eggs of the common cuckoo, associated in a large number of cases with the clutches laid by their involuntary foster-parents. After remarking on their variability in size, the authors state that the cuckoo's eggs likewise present a considerable range of diversity in colour and the character of the marking, although the great majority approach in these respects to the eggs of the meadow-pipit and skylark. Eggs of this type constitute the great bulk of the series in the collection. Some, however, like those associated with the eggs of *Ruticilla phoenicurus*, are blue, while one closely resembles that of a chaffinch. Curiously enough, cuckoos' eggs from hedge-sparrows' nests are of the ordinary type, and show no tendency to become blue. Altogether, the collection includes cuckoos' eggs taken from no less than forty-one different species of birds, ranging in size from a shrike to a fire-crest.

Did space permit, many other interesting points connected with öology might be mentioned; as it is, we must bring our remarks to a close with the expression of our opinion of the great interest of this unique work. R. L.

MODERN SCIENCE POPULARISED.

New Conceptions in Science. By Carl Snyder. Pp. xii+362. (London and New York: Harper and Brothers, 1903.) Price 7*s.* 6*d.* net.

IN the absence of any preface, it is necessary for the reader to form his own opinions as to the aim or object of the book considered as a whole. This, evidently, is to arouse an interest in scientific work among unscientific people by telling the story of the discoveries of the day in unscientific language. We have here portraits of the man that weighed the crown of King Hiero, of the man that broke the atom into ions, of the man that caught and fought the deadly microbe, and other pioneers of science introduced in terms somewhat suggestive of those we have used above. Several of the illustrations show the discoverers at work in their own laboratories, and remind us that this book hails from the same land which in recent years has flooded our breakfast tables with portraits of literary men writing articles by the side of revolving bookcases.

We have spoken of the book as being written in unscientific language, but it would be better to describe the language as unconventional, unorthodox, and very funny to an English mind. As instances, we may quote "chips of atoms" as applied to corpuscles; Marconi is described as having "since the Salisbury Plain trials with kites, taken to the water wholly," and, later on, it is said of him, "Then the tireless experimenter looked out over waste seas, saw in fancy the foggy banks of Newfoundland and said confidently 'That's the next.'" Again, "The Hertz-waves have had a sort of Messianic history. They had been foretold." "This scale" (speaking of Centigrade) "is in universal use throughout the world save in two backward countries called England and the United States." (The author forgets that there are certain enlightened countries which still use Réaumur's scale.) "If like this mechanical eye our eyes were sensitive to these electrical waves, then we might watch the progress of a play in Buenos Ayres or have witnessed the struggles at Peking." "Those who were reared to the ideas of Clerk Maxwell, regarding electricity as a wave and wobble in the highly hypothetical ether, have not failed to implant upon the new theory their collective feet." Light and other waves are stated to "clip through space at 184,000 miles per second." "If, as Prof. Dolbear picturesquely remarks, we could some way get a 'kick' on the ether, space navigation would be easy. It does not seem impossible that we shall be able to do this within another hundred or two hundred years."

The book is not confined to physical science alone. It contains a chapter on Prof. Loeb's discovery of artificial parthenogenesis, another on the nature of life, in which is suggested the possibility of reversing the life processes and growing backward, and a chapter headed "The Spirit Rappers, the Telepaths and the Galvanometer." Seriously speaking, the most important chapter is undoubtedly that dealing with "America's Inferior Position in the Scientific World." In it, among other points, the author urges the necessity of founding an institution like our Royal Institution in America, and directs the attention of his fellow countrymen to their general backwardness in research. We over here are apt to think of the American man of science as being pretty well off in view of the large number of universities existing in the United States, and the large number of chairs attached to each of them, which should result in the individual professors having far more time for research work than they have in this country. If, however, the author succeeds in impressing on his fellow countrymen the need of devoting further endowments for the furtherance of research work pure and simple, the book will not have been written in vain. The danger is that the important part played in science by long formulæ involving *dx*'s and *dy*'s, inverted deltas and signs of integration will be overlooked. G. H. B.

APPLIED PSYCHOLOGY.

Outlines of Psychology: an Elementary Treatise with some Practical Applications. By Josiah Royce, Ph.D., LL.D., Professor of the History of Philosophy in Harvard University. Pp. xxvii + 392. (New York: the Macmillan Company; London: Macmillan and Co., Ltd., 1903.) Price 4*s.* 6*d.* net.

THE number of persons who are anxious to study psychology in order to make themselves more efficient as teachers is already large, and is happily

increasing very rapidly. This book is designed to introduce them to the study of the subject, and may be warmly recommended to them, but it is worthy of the attention of the professional psychologist also. The special features of the book are the freshness and clearness of the treatment, and the novel arrangement of mental phenomena under the three heads sensitiveness, docility, and initiative. Prof. Royce thus ignores the traditional divisions of the subject, which, though merely survivals from the old and misleading faculty-psychology, have largely determined the mode of treatment of most modern writers. By so doing he is enabled to treat every mental process as a whole having cognitive, conative and affective aspects.

Though not himself an experimenter or a physiologist, Prof. Royce fully and generously admits the importance of physiological and experimental psychology, and recognises that the advance of the subject represented by this book is largely due to modern work by those methods; his sketch of the functions of the nervous system and his numerous references to physiological considerations are altogether admirable and judicious, and he shows how greatly experimental methods have furthered our analysis of mental processes.

Here and there throughout the chapters practical deductions of the first importance to teachers are clearly and soundly drawn; for example, it is admirably shown how "differentiation of the simultaneous slowly results from the repeated acts, and from the powers of discrimination which have been cultivated in connection with them," and there follows the maxim, "Undertake to systematise this differentiation of consciousness through fitting series of successive deeds."

One of the most novel features is the treatment of the feelings. While agreeing with Wundt in regarding the classification of feelings into the two groups, pleasant and unpleasant, as very inadequate, Prof. Royce does not accept that author's six classes, but regards feelings of quiescence and of restfulness as two classes of antagonistic feelings correlative with the pleasant and unpleasant. In the chapter on the conditions of mental initiative, the importance of this distinction is fully illustrated. It is there forcibly shown how "mental initiative" depends upon "a certain overwealth of persistent activities" not immediately adaptive and not necessarily pleasant, and it is asserted that "all such activities are characterised by the feeling of restlessness. In their physical aspects they are examples of the 'tropisms' of Loeb." This last statement is difficult to accept. In the introduction Prof. Royce shows that he has been much impressed by the phenomena of "tropism" as manifested by lowly organisms, and he seems to feel that the conception of the "tropism" is of great importance for psychology. But the later references to the subject do little to justify the expectations thus aroused. In the case of the "overwealth of persistent activities" which are so important for mental growth, it would seem to be truer to say that they are examples of "irritability," the fundamental property of all living substance, and to treat them as examples of "tropisms" is not warranted by any considerations advanced in the book or known to the present writer.

The concluding chapters deal with varieties and abnormalities of minds, and many valuable hints are given as to the special treatment of individuals demanded of the teacher and parent. Among all the many books on psychology, there is none that within so small a compass, can give more insight into the life of the mind, and none that can be studied by schoolmasters with greater or equal advantage to their professional efficiency. W. McD.

OUR BOOK SHELF.

Animal Studies: a Text-book of Elementary Zoology for Use in High Schools and Colleges. By David Starr Jordan, V. L. Kellogg, and Harold Heath, of Leland Stanford Jr. University. Pp. 459; 259 figures. (New York and London: Appleton and Co., 1903.) Price 5*s*. net.

THIS is an interesting and delightful text-book of elementary zoology, combining some parts of "Animal Life" and "Animal Forms," in the same series, with new material on classification, extinct forms, geographical distribution, special adaptations, instincts, and economic value. Beginning with chapters on the conditions of animal life and the principles of classification, the volume takes a survey of the most important classes from Protozoa to mammals. Then follow chapters on life-histories, the struggle for existence, adaptations, animal communities, commensalism and parasitism, protective resemblances and mimicry, the special senses, instinct and reason, and so on. When we compare a school-book on geography of a quarter of a century ago with the best modern school geography, we seem to breathe a different atmosphere, and so it is when we compare the natural history for schools which was in circulation twenty-five years ago with this lively, up-to-date, well thought-out, beautifully illustrated, and, in short, well adapted modern school text-book of zoology.

We quote, in illustration of its educational value, one example:—"At one time we had two adult monkeys, 'Bob' and 'Jocko,' belonging to the genus Macacus, neither with the egg-eating instinct, and a baby monkey, 'Mono,' of the genus Cercopithecus, whose inherited impulses bore a distinct relation to feeding on eggs, just as the heredity of Macacus taught the others how to crack nuts or to peel fruit. To each of these monkeys we gave an egg, the first that any of them had ever seen." The result of the experiment was in the highest degree instructive. Mono cracked the egg against his upper teeth, made a hole in it, and sucked it. "Then holding the egg-shell up to the light and seeing that there was no longer anything in it, he threw it away." He treated all subsequent eggs in the same expert fashion, while "Bob" and "Jocko" treated their eggs like nuts, and therefore ineffectively.

We recommend this book strongly; it is simple but not superficial, it is both interesting and instructive; it is written with an educational perspective. It is particularly desirable in elementary books that every general statement should be critically scrutinised, and the standard of accuracy in this volume is a high one. We are not, however, prepared to accept every statement, *e.g.* that fur-seals "absorb the water needed through pores in the skin." J. A. T.

Das Zeisswerk und die Carl-Zeiss-Stiftung in Jena. Ihre wissenschaftliche, technische und soziale Entwickelung und Bedeutung, für weitere Kreise dargestellt von Felix Auerbach (Prof. a.d. Universität). Pp. vi+124. (Jena: Gustav Fischer, 1903.)

This short popular account of the optical works in Jena will be of interest to a wide circle of readers. Of the successful application of science to industry no more striking illustration can be found than in the history of the Zeiss firm, with its aim of "scientific exactness and perfection of workmanship," while to many the description of the present organisation of the undertaking, and the socialistic features of the charter under which it is now controlled, will no less appeal.

The early efforts of Carl Zeiss towards the improvement of the microscope, his adoption of Abbe as scientific partner, and the revolution in the optical theory of the instrument due to Abbe's work, are dealt with in some detail. The need, emphasised by Abbe's investigations, of greater variety in the character of optical glass, to render possible the removal of the chief defects of lens systems, led to the foundation, in 1884, of the glass works of Otto Schott, and from this year we may date an enormous advance in the construction of optical instruments, with a further development of the Jena industry. This brings us to an account of the existing organisation, and a description of the main departments, with details and illustrations of many of the most important and best known instruments, as well as of the workshops and buildings.

The latter part of the work deals with the social and socialistic aspects of the present system of administration. In 1891, some four years after the death of Carl Zeiss, Abbe devised his rights of property in the optical and glass works to the undertaking itself, and originated the statute, under which, after receiving in 1896 the legal sanction of the Duke of Saxony, the "Carl-Zeiss-Stiftung" is now controlled. Particulars are given of the statutory standing of the employés, the system of profit-sharing, the regulation of hours of work, the pension scheme, as well as of institutions founded for the benefit of the workmen, and benefactions to the university and to the town.

In addition to Carl Zeiss and Abbe other personalities connected with the undertaking, Schott, Czapski, Straubel, Pulfrich, &c., are briefly characterised, and with these names may be also mentioned that of the old foreman, August Löber, to whom the firm is indebted for many improvements in technical detail.

Reasons Against the Theory of Evolution. By Thomas Woods, M.D., M.R.C.S.I., L.R.C.S.I., &c. Pp. viii+52. (London: W. R. Russell and Co., n.d.)

The author of this booklet may have perfectly definite convictions as to the truth or falsity of the theory of evolution, but he has hardly succeeded in making his attitude towards the doctrine clear to his readers. His object, the preface informs us, is to notice some occurrences, said to be due to evolution, the contrivances for which must have been pre-arranged, and therefore could not have been the result of accidental circumstances. "If," he proceeds, "Evolution results from 'circumstances and surroundings,' pre-arrangement, of course, cannot have occurred, and if it can be shown that such pre-arrangement has in *any* instance taken place the whole thing must fall." This can only mean that the author considers himself in a position to disprove the existence of evolution *in toto*. But, on the other hand, we read that "if we regard Evolution as *one* of the means made use of, . . . we may not err." We do not see how these statements are to be reconciled.

Considering, however, the title of the essay, and the whole tone of the author's remarks, we shall probably be doing him no injustice if we put him down as a root and branch opponent of the theory as commonly understood. His leading argument appears to be this:—facts such as the grouping of the planets of the solar system, the freezing and boiling points of water, and, in the organic world, the provision made by nature for the welfare of unborn offspring, with other similar conditions, seem to stand in definite relation with the existence of life on the earth; these conditions must have been pre-arranged, and therefore evolution is impossible. It is scarcely necessary to point out that the argument is a *non sequitur*. In estimating the evidence for and against evolution, it is absolutely immaterial to inquire whether the conditions under which it is supposed to have taken place are or are not the result of "pre-arrangement." Dr. Woods claims in an appendix to have anticipated Favre and Silberman in laying the foundations of thermochemistry. It is unfortunate that in entering the lists of biological controversy he has omitted to acquaint himself with the elementary conditions of the evolutionary problem.

Lessons in Physics. By Lothrop D. Higgins, Ph.B. Pp. vii+379; with plates and diagrams. (Boston, U.S.A., and London: Ginn and Co., 1903.) Price 4s. 6d.

It is rather difficult to "place" this book. At the end there is a glossary in which (amongst more difficult ones) words are defined such as these: absorb (to take in), alter (to change), constant (always the same), detect (to find out), enlarge (to make larger) Apparently, then, the pupil is not expected to be certain about words of two syllables. We, accordingly, look for great simplicity in the text, especially as the author in his preface trusts that the explanations "have been made with a care which should render them unusually clear and simple." We open the book at random at the first section on magnets, and find the following definition as the first sentence:—"A Magnet is a body so acted upon electrically that it has the power to exert magnetic force."

We open on p. 319, and we find Ohm's law based upon the relative values of E.M.F. and current in the primary and secondary of an induction coil.

We open again at p. 250, and learn, in explanation of the rainbow, that "the sunlight passes through some thin clouds whose particles of water refract the rays, and the spectrum is formed on other clouds or reflected to the eye."

The first 120 pages, on mechanics, appear to be the best part of the book. There are several remarkably pretty plates.

The Certainty of a Future Life in Mars. Being the Posthumous Papers of Bradford Torrey Dodd. Edited by L. P. Gratacap. Pp. iv+266. (New York: Brentano's, 1903.)

The planet Mars has been the subject for many works of fiction, and in the present volume we have another addition to the list.

The main idea of the train of thought in these pages is that upon each planet the possibilities of development just attain to the margin of the next higher step in mental evolution. Thus in Venus the period of *sense* develops to the possibility of the period of *science*, but does not attain it. On the earth the period of *science* develops to that of *spirit*, while the latter is only reached in the planet Mars. On this assumption souls of different degrees move from planet to planet.

The chief characters in this story are Mr. Dodd, his wife and son (the author of these papers). The father and son work out a system of wireless telegraphy, and

after the death of the former, whose soul is transported to Mars, they get into communication with each other.

The posthumous papers consist of the record left by the son, who describes all their experiments, hopes, failures, successes, and, lastly, the extra-planetary wireless messages he received.

Those interested in this class of fiction can spend a pleasant hour or two over these pages.

On the Lakes of South-eastern Wisconsin. By Prof. N. M. Fenneman. *Bulletin* viii. of Wisconsin Geol. and Nat. History Survey. Pp. xv+178. (Madison, Wisconsin: Published by the State, 1902.)

The preface and the introduction announce the object of this work. It is intended as a guide to the teacher of geology, and shows how the shores of these lakes may form beautiful illustrations of the principles of wave, current, and ice action. The first chapter gives a general account of the origin of such lakes, and the second is devoted to a general and more or less theoretical discussion of the geological agents at work. After this the lakes are taken up one by one, and it is shown how the various features of the shore have arisen. There are many very good and aptly chosen photographs, which bring out clearly the points mentioned in the text, and make the book interesting even to those who cannot see the lakes for themselves.

Most of the book is devoted to the features of the shores, but it is also shown how the hydrographic maps may be used to decipher the origin of the basins, and in the case of Lake Mendota there is an interesting discussion of the results obtained by dredging, which are said to indicate currents below the wave-base. The unpublished work of the director of the Survey, Dr. Birge, on the temperature of these lakes is also said to confirm these conclusions. We shall look forward to the publication of these temperature observations. E. R. W.

Malessere Agrario ed Alimentare in Italia. By Italo Giglioli, Direttore della R. Stazione Agraria di Roma, &c. Pp. lxxxii+707. (Portici, 1903.)

In this work Prof. Giglioli has attempted a detailed survey of the agricultural state of Italy in comparison with other nations. He considers one by one the various branches of the industry, the production of wheat, maize, rice and other cereals, wine, fruit, olives and silk, eggs, butter, cheese and the many minor branches of rural activity which are possible in the climate of Italy. In each case a comparison is drawn between the conditions of the past and those which prevail to-day both in Italy and the chief competing countries. Both as an ardent patriot and a man of science, Prof. Giglioli is troubled by the increasing poverty of the rural districts as compared with the towns, especially when one travels out of the favoured northern provinces of Lombardy and Tuscany into middle and southern Italy. He indicates how the actual production of the land is declining, so that Italy with all its traditional farming skill and with the vast possibilities of its climate is coming to be more and more dependent upon other nations for food which could be grown within its own borders if only more intensive methods of cultivation were resorted to. Aggravated as the case is in parts of Italy by the poverty of the people and their entire dependence upon agriculture, the problem is one which all the west European States are being called upon to face; how can agriculture, which is a primitive industry, live in a highly civilised State against the competition of the great areas of virgin soil like Argentina or the North-West? To English economists who want an enlightened and temperate review of the situation in a nation not unlike our own we commend Prof. Giglioli's book.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* Nature. *No notice is taken of anonymous communications.*]

Does the Radio-activity of Radium depend upon its Concentration?

Some experiments have recently been made to test whether the radio-activity of radium is influenced by the continuous bombardment to which it is subjected by its own radiations. In an article in this Journal on radium (April 30, 1903) Prof. J. J. Thomson suggested that the radio-activity of radium may possibly depend upon its degree of concentration, and that a given quantity of radium, diffused throughout a mass of pitchblende, may be less than when concentrated in a small mass. In order to test this point, measurements of the radio-activity of radium bromide were made when in the solid state and when diffused throughout the mass of a solution more than a thousand times the volume occupied by the radium compound.

Two tubes, closed at one end, were taken, in one of which was placed about a milligram of pure solid radium bromide and in the other a solution of radium chloride. The tubes were connected near the top by a cross tube, and the open ends were then sealed by a blowpipe.

Measurements of the radio-activity of the radium were made by means of an electroscope. The tubes, fixed on a stand, were placed in a definite position near an electroscope and the rate of discharge observed. This was due to the β and γ rays emitted by the radium, since the α rays were completely absorbed in the walls of the tube. By placing a lead screen 6 mm. thick between the tubes and the electroscope the rate of discharge was due to the γ rays alone.

After measurements of the activity had been made, the glass apparatus was tilted so as to allow the radium chloride to flow into the arm containing the radium bromide. This dissolved the radium, and part of the emanation was released and distributed itself throughout the tubes.

No appreciable change of the radio-activity of radium was observed over a month's interval. If the rate of production of the emanation, or the excited activity caused by it, had varied during the interval, a corresponding change would have been observed in the rate of discharge due to the γ rays, for other experiments have shown that the amount of γ rays is proportional to the amount of emanation present, provided measurements are made several hours after the introduction of the emanation into a vessel, in order to allow the excited activity to reach a maximum value. The rate of discharge due to the γ rays was somewhat diminished, but this was due to an increased absorption of the β rays by the solution, and not to a change in the rate of emission of these rays. On account of the great penetrating power of the γ rays, the increased absorption due to the presence of the solution was negligible.

Since, after solution, the radium bromide was diffused through a mass of solution at least 1000 times the bulk of the solid radium bromide, we may conclude that a distribution of the radiating matter over a thousand times its original volume has no appreciable influence on its radio-activity.

This experiment shows that, over the range investigated, the radio-activity of radium is not influenced by its own intense radiations. This result is in agreement with previous observations, for neither the radio-activity of any active product nor the rate of loss of its activity has been found to be affected by its degree of concentration.

It is thus improbable that the energy given out by radium is due to an absorption of an unknown external radiation which is similar in character to the radiations which are emitted. Experiments are in progress to test whether still further dilution of the radium solution produces any alteration in its radio-activity. E. Rutherford.

McGill University, Montreal, December 18, 1903.

Relative Motion and Conservation of Energy.

I have received a letter from a correspondent which has led me to think that certain points connected with elementary dynamics are very obscurely put forward in text-books and in elementary class teaching generally. Of these the following may be taken as examples:—

(1) A river is flowing at three miles an hour. If two steamers are ascending the river, making headway at the rate of three miles an hour, one propelled by the action of paddle wheels or a screw, and the other pulling itself up by means of a chain laid along the bed of a river, the former will have to exert twice the horse-power of the latter, although the resistance overcome and the distance travelled in any given time are the same in both cases. Why is this?

(2) If a man is standing in an express train going at sixty miles an hour, he will have to perform exactly the same amount of work to throw a body of mass 1 lb. forwards with a relative velocity of sixty miles an hour as if he threw it backwards with the same relative velocity.

Yet in the former case the kinetic energy of the mass is increased from 121 to 484 foot pounds, while in the latter it is decreased from 121 foot pounds to zero. The actual work done by the man is in every case 121 foot pounds. This result has the appearance of being in contradiction with the principle of work.

I have known many Cambridge lecturers who, when they attempted to solve problems of a similar character, arrived at very different results. I am able to account for the apparent contradictions of the principle of conservation of energy, although I did not learn to do so from text-books. The majority of readers of NATURE are also, doubtless, competent to explain them in their own way and to their own satisfaction. But a student reared on the conventional text-book cannot fail to think (if he exercises his thinking powers at all on the subject) that the laws of dynamics must be at fault somewhere.

G. H. BRYAN.

The Universities and Technical Education.

HAVING just read Prof. Perry's address on "Oxford and Science," I am tempted to give my own views on technical education for the Government service, and especially for the service of India, with which I have been connected since 1869. My qualifications for this discussion are chiefly that I was Director of the Imperial Forest School at Dehra Dun, in India, for five years, and Deputy Director of that school for four years, and during those nine years I always instructed the students personally in one of their branches of study. The excellence of the Dehra Dun Forest School has lately been recognised by the French Government, which has decided to send its Tonquin and Cochin China foresters there to complete their technical training, after having learned European forestry at Nancy.

My experience in India has been that men who have taken university honours degrees in science make the best scientific Government servants, but need special training at a technical college to complete their education for the public service, just as candidates selected for the Indian Medical Service, after receiving a thorough European medical training, complete their education at Netley. The Government of India fully recognises the advantages of a university training for its administrative and judicial service, commonly known as the Indian Civil Service, of which it is the most important branch, also for its Educational and Geological Departments, and the head of the Indian Meteorological Department always comes from a university. Why not also candidates for its Engineering and Forestry Departments? For these important departments, at present, boys are recruited chiefly from the public schools, where they may or may not have acquired the rudiments of scientific knowledge. Surely better candidates could be obtained if the age-limit were raised, and men trained in science and who have obtained an honours degree at a university were taught the technical part of their business at a well equipped Government college, such as the Royal Indian Engineering College, Coopers Hill.

At present there is too much overlapping of studies at technical colleges, and immature students are hurried through their preliminary scientific studies and have not the necessary time to devote to subjects which will form their future life-work. The London medical schools are instances of this. With the best clinical instruction available at the London hospitals, each of these institutions maintains with difficulty a more or less complete staff to teach botany, physiology, &c., which should be taught at a central university. There would be a great saving of expenditure at technical colleges, and much greater efficiency, were the scientific education which is a necessary preliminary to technical knowledge acquired under the distinguished guidance of university professors. By passing through a university, candidates for the higher posts in the Government service would experience the excellent social atmosphere of the university by mixing with men who are preparing for all the different professions and positions in life, and would have a much broader training than is possible at a purely technical college, where there is always the danger of narrow views, and of the overcrowding of subjects of instruction.

I hear that men who have taken a degree at Cambridge in the excellent mechanical school there are readily admitted without paying fees to complete their technical training in large engineering workshops, and surely a wider knowledge of engineering could be obtained at a Government college, such as Coopers Hill, than at any private engineering workshop, where the work done must be of too special a character for Government service. The University of Cambridge does not contemplate being able to turn out finished engineers, but only men preliminarily trained for engineering, neither does it contemplate educating practical foresters, but merely men who have obtained a diploma in the theory of agriculture and forestry. There is a demand in the colonies, as well as in India and Egypt, and by some foreign countries, for English-speaking professors of engineering and forestry, as well as for trained engineers and foresters, and at present the supply of such men is quite inadequate, and frequently these appointments are given to foreigners, simply because properly trained men from our country are not available.

Forestry can be admirably taught at Coopers Hill, with 14,000 acres of the Windsor Forest at our doors, and with examples of forests at Alice Holt Wood, in the Chiltern Hills, and elsewhere, easily accessible by train. The splendid forests of the north of France are within a day's journey, while, after a six months' practical training in the German forests, no forester in the world can be better equipped than are our students. Were our first year students university men instead of schoolboys, America and the colonies would be tempted to send us more students, and one of the finest technical colleges in the world might be easily established.

Coopers Hill, January 1. W. R. FISHER.

Prof. Johannsen on Heredity.

I SHOULD be glad if you would allow me space for some remarks on two recent reviews of Prof. Johannsen's "Erblichkeit in Populationen," in the last issues of *Biometrika* and of NATURE (December 17) respectively, the former signed by Prof. Pearson and Prof. Weldon.

I find it difficult to understand Prof. Johannsen's book in the sense in which the reviewers have, apparently, read it. In both notices it is stated that, if the author's views were correct, the correlation between mother and daughter plants should be perfect. As I take it, however, Prof. Johannsen's view does not imply, and is not consistent with, such a hypothesis; he believes, and adduces evidence to show, that within the pure line "Der Rückschlag ist vollkommen, ganz bis zum Typus der Linie," and explains the result on the hypothesis that the germ-plasm structure (or whatever we may term it) for the pure line is constant, the variations purely somatic. Neither the existence of zero correlation between parent and offspring nor the assumed somatic character of variations, within the pure line, is consistent with perfect correlation between parent and offspring for the race at large. This misunderstanding, in my view, is fundamental.

With reference to the concluding paragraph of the review in NATURE, it may be pointed out that Prof. Johannsen undertook the definite task, clearly stated, of elucidating the nature of intra-racial heredity by the study of heredity within the pure line, *i.e.* the offspring of one self-fertilised individual. He has shown that the intensity of heredity between the first two generations sprung from such a single individual may be vanishingly small, although it is quite sensible within the race at large. The result is of great importance both as regards the theory of heredity and the practice of breeding, and the work cannot be termed in any sense a failure.

One would, certainly, wish that Prof. Johannsen had employed more advanced statistical methods, and one may

(as I do) dissent from some of his conclusions; but the methods he has used are legitimate and sufficient for his immediate purpose, and, in my opinion, the work as a whole is one of the most stimulating contributions to the study of intra-racial heredity published in recent years.

December 22, 1903. G. UDNY YULE.

WITH regard to Mr. Yule's view that there is a fundamental misunderstanding in our notice of Prof. Johannsen's book, we must direct attention to the problem at issue summed up in the words "Der Rückschlag ist vollkommen ganz bis zum Typus der Linie." The character selected for measurement by Prof. Johannsen either fully determines the type or it does not, *i.e.* in the latter case it may be subject to somatic variations having no influence on offspring as Mr. Yule suggests. If it does determine the type, then the correlation between the parent and the mean of the offspring should be perfect, and this it certainly is not. If it does not determine the type, the correlation might be imperfect because the character of the line would not be perfectly known. But since the parental character is in this case not perfectly known, it is clearly impossible for Prof. Johannsen to determine the type, and thus his experiments must fail to show whether the "Rückschlag" is perfect or not. This point is referred to in the reviews cited by Mr. Yule, but it seems to have escaped his notice.

In the next place Mr. Yule *asserts* that Prof. Johannsen has shown that the intensity of heredity between the first two generations sprung from a single individual may be vanishingly small. This is precisely what he has failed to do. To deal with heredity the *same* character must be selected in two successive generations, and this, as pointed out in the review in question, Prof. Johannsen has not attempted.

The remainder of Mr. Yule's letter being neither a reasoned defence of Prof. Johannsen's book nor a criticism of our review calls for little comment; it will command from the reader just that degree of assent which he may be accustomed to give to mere opinion very authoritatively stated. Mr. Yule's estimate of the value of Prof. Johannsen's experiments and statistical methods differs widely from that expressed in our review, but nothing is gained either in criticism or controversy by the mere posing of a rival *ipse dixit*. THE REVIEWER.

The Heat of Radium.

A NUMBER of years ago I published a theory of the formation of the elementary bodies, based on polymerisation and its reversal. The numerics ("atomic weights") of the elements show an increasing accordance with that theory as time goes on.

Of our existing system of numerics the polymerisation points are comprised in the expression n 15; they are, 15, 30, 45, 60, 75, 90, 105, 120, 135, 150, 165, 180, 195, 210, 225, 240. As chemical change in general exhibits a great tendency to run down, we may fairly assume that most of the earlier reversals have already occurred, and that such as remain will be associated with elements of high numeric.

It is clear that polymerisation must involve the emission of heat, and I am strongly disposed to regard radium (Ra = 225) as the product of a "stoff" in the act of polymerisation, the reversal being well indicated by the discharge of helium (He = 4).

It is interesting to notice that Sb (= 119.5) and Sm (= 149.9) are extremely near polymerisation points. It would be worth while to examine compounds of these bodies for emitted heat and gaseous or other matter.

The emanation phenomenon would also appear to be in some way related to the same points. It is, for example, stronger in U (= 238) than in Th (= 231.7). Both these bodies, and the substances they emit, should be derived from a hitherto unknown polymer (= 240) undergoing reversal into simpler bodies. EDMUND J. MILLS.

January 4.

Rocket Lightning.

MY attention has been directed to a letter in your issue of October 22, 1903, describing certain flashes of lightning that were visible on July 22. In many respects the flashes corresponded with flashes seen by myself and friends at the same hour on the same evening, but the discrepancies are remarkable. For instance, Mr. Everett, in the letter referred to, saw flashes "bearing a strong resemblance to ascending rockets, a luminous trail shot up about as fast as, or rather faster than, a rocket," whereas we saw flashes that appeared with about the ordinary rapidity. There certainly was a strong suggestion of ascension, but vertical lightning flashes quite commonly exhibit this appearance, which sometimes at least is due to an optical illusion.

The bearing of the flashes as seen by us, from the verandah of a house in Camac Street, was N. 143° W., and as the Sibpur College bears, from our position, N. 86° W., about 16,500 feet distant, it would be quite easy to calculate the position of the flashes if Mr. Everett had noted their bearing accurately. His description of the bearing as "in the S.S.W." suggests that this is only intended as a general indication of the direction. If S.S.W. were the exact direction, the flashes could only have been 10½ miles distant from Mr. Everett and 12 miles from us, but if the direction were the next point of the compass, S.W. by S., the flashes were 50 miles away. This greater distance is probably nearer the truth, because if the flashes were only 10 or 15 miles distant thunder would have been audible.

Again, the angular altitude of the highest part of the flash is given by Mr. Everett as "15° or so," which does not agree with our observation of 10° or a trifle under, perhaps nearer to 9°. At a distance of even 30 miles there should have been no observed difference of maximum altitude between Mr. Everett's observation and ours.

In other respects the observations tally precisely. The vertical flashes appeared repeatedly in the same position against a background of clear sky, so clear that a star, ζ Centauri, was visible at an altitude exceeded by the flash.

Mr. Everett falls into an error in supposing that the lightning "must have occurred at a spot above the Sunderbunds." The direction of the Sunderbunds is not westerly, but easterly from the Sibpur College, and the flashes must have been over some part of the Twenty-four Perganas if not more than 25 miles away, over the Midnapore district if more than 35.

As to there being "not a score of men in all Bengal who would take a serious interest in such lightning if they did happen to see it," I am not aware of the precise number, and can only vouch for three, the manager of a railway, another competent observer, and myself, who observed together, but I should not be surprised if the flashes were also seen by other observers equally able to record their observations accurately. W. A. LEE.

Calcutta, December 10, 1903.

I GATHER from Mr. Lee's account that he only witnessed one kind of lightning, whereas my son's letter describes two kinds altogether different in appearance. The inference would seem to be that the less brilliant and more unusual kind was not visible in the centre of Calcutta, though visible at Sibpur, probably owing to better atmospheric conditions. J. D. EVERETT.

11 Leopold Road, Ealing, December 30, 1903.

The Recent Leonid Shower.

THE results of the observations by M. Eginitis of the recent Leonid shower indicate that there was another maximum on the night of November 15, occurring several hours previously to that seen by observers situated in or near the longitude of Greenwich. This early maximum was evidently of a very distinct character at Athens, as the observations showed a regular increase and decrease of meteoric frequency before and after the time of culmination (15–16h., local time), the watch having been prolonged for some hours further, or until 17h. 50m. Athens was evidently too far east to permit observers there taking cognisance of the later outburst of meteoric activity that added considerably to the strength of the shower here. The maximum mentioned by M. Eginitis does not appear to have been very noticeable as such to British observers, though it was anticipated here that that event should occur on November 15 at 13h. 30m. G.M.T., the calculated maximum thus falling within the hour, when we allow for the difference of longitude, during which it was actually observed at Athens. The later maximum came altogether unexpected. It is noteworthy that these maxima seem to have been characterised by quite a distinct type of meteor.

Dublin. JOHN R. HENRY.

CENTRAL ASIAN EXPLORATION.[1]

DR. SVEN HEDIN'S latest book possesses an interest for the great world of travellers which is apart from its intrinsic merit as a traveller's record. The blank spaces of the world's map are becoming so narrow; there is so little left for the exploring enthusiast to mark with his pioneer footsteps, that books of this nature must necessarily grow scarcer as the world grows older. This may be one of the last of a grand series which has educated the world (in divers tongues) since the days of Herodotus. The finger of the North Pole still beckons to us, as does that of the South; there are still a few sand wastes in the interior of Arabia, and a few thousands of forest leagues in the interior of South America which have not yielded up their secrets to the keen eye of scientific inquiry—but that is about all. It is the unattractive emptiness of the wildest and most desolate wastes which still remains to be explored, so that the tale which has yet to be told of them will be told by none but men of the true race of the world's heroes of research men of the stamp of Peary and Sven Hedin—who explore because, to them, the first acquisition of knowledge of the unknown is the one thing that makes life worth living.

The story that is now told by Sven Hedin is one of stirring personal adventure leading to discoveries in a very old world rather than in a new one, and instinct with the interest of human history. He tells it well, introducing to us the companions of his travels one by one, making us acquainted with their weaknesses and their strength, familiarising us with his surroundings, his horses, and his dogs (and even those usually uninteresting brutes, his camels), until we can see the whole of this little Central Asian caravan moving across the deserts and through the mountain defiles as if we were one with them, hoping their hopes, fearing their fears, and deploring with them the loss of those brave helpers who fall by the way. No novel could carry the reader along with the course of its plots and its evolutions until the final dénouement more completely. Sven Hedin is a good English scholar himself, and he is to be congratulated on his choice of a translator. Very few books of travel written, as this is, in diary form avoid the Scylla of dulness without wreck on the Charybdis of untruth. A little poetic licence is usually necessary to enliven the narrative. But here any man who has seen anything of those remote Asiatic fields which Sven Hedin describes, recognises at once the atmosphere of absolute truthfulness in which the drama moves. There is not a risk incurred, not a danger (and the whole record is full of them) escaped, which is not the natural sequel of the daring conception of each phase of the three years' journeying—not one which any traveller could reasonably have hoped to avoid had he marked out for himself Sven Hedin's expeditions with Sven Hedin's courage.

His first enterprise, the voyage down the Tarim River, to its ending in the desert, illustrates the marvellous patience and pertinacity of the man. To most people it would have been enough to glide gently down the stream watching the changing lights and shadows and the glorious autumn tinting of the poplar woods, and to have made a record at the end of each day's run of its general direction and its terminal latitude. This was not good enough for Sven Hedin. Hour after hour he sat at his work in the boat, mapping each turn, each curve, in the twisting, winding stream, noting its depth, the strength of its current and its peculiarities, until sometimes sixteen hours a day of intermittent work was achieved without once leaving his table. If genius is an "infinite capacity for taking pains," then indeed does Sven Hedin possess that desirable attribute. It must be noted, too, that in a desert like that of the Takla Makan, such natural hydrographic features as exist must inevitably change almost from year to year. There is no more permanency about the course of the Tarim River than there is about the "locus" of Lop Nor. All Sven Hedin's magnificent map making may require serious correction within the next few years.

The very centre of interest in Central Asian geography lies in the Lop Nor region. The former existence of a high road across the desert connecting the outlying city of Western China, Sachow (Saitu), with Yarkand and Kashgar by a route skirting the northern spurs and outlying ridges of the Altyn Tagh (Astyn Tagh, according to Sven Hedin) to Cherchen, and

FIG. 1.—Tibetan Soldiers. (From "Central Asia and Tibet.")

thence following the Cherchen River until it again touches the northern foot hills of the Kuen Lun, and thus extends itself to Nia and Khotan, has long been recognised; but we must now accept the theory of a more direct road westward connecting Sachow with the ancient city of Lou Lan, so well described in Sven Hedin's book. Lou Lan was a small and independent State in the early centuries of our era, dovetailed as a buffer between China and the Turkish Hun tribes, who together appear to have rendered its political life as uneasy as more modern buffer States have found such a life to be. That this isolated State existed only by grace of the existence of the Lop Nor Lake is sufficiently proved by its total disappearance when the waters of Lop Nor (the old bed of which lake is placed further north by Sven Hedin than our existing maps show it—about midway between the Altyn Tagh on the south, and the Kurruk Tagh on the north) shifted southward. This was no case of sand burying. The whole water supply of the district gradually withdrew to another position, forming new lakes on the inconceivably flat surface of the desert some fifty miles away; and the extraordinary feature about this move-

[1] "Central Asia and Tibet." By Sven Hedin. Vol. i., pp. xvii+608; vol. ii., pp. xiv+664. (London: Hurst and Blackett, Ltd., 1903.) Price 42s. net.

ment is that the lakes which were so formed appear now, after many centuries, to be in the process of transferring themselves once again to their old place, the place which was assigned to them in early Chinese maps.

It is characteristic of the thoroughness of the work of this great traveller that he actually levelled the land surface between the ancient Lop Nor depression and the Kara Koshun (the present lake bed), and has proved beyond dispute the theory of a migratory, or moving, lake. That Lou Lan was Buddhist is sufficiently attested, not only by the nature of the relics discovered on its site, but by the peculiar construction of those solid brick erections which Sven Hedin calls towers, but of which the photographs quite clearly indicate the nature. They are Buddhist topes or stupas. Thus we have another link in the long chain of Buddhist centres (temples and holy places) stretching from Western China through the deserts, past the group of towns unearthed by Stein, broken for a soace by the intervening Himalayas, and then recommencing in the valleys of Gilgit, Darel and Swat, until it ended in the valley of Peshawar.

The last part of Sven Hedin's story is devoted to

FIG. 2.—Ruined house with its doorway standing *in situ*. (From "Central Asia and Tibet.")

his gallant but unsuccessful attempt to reach Lhasa. Beyond doubt he was betrayed by the Mongol pilgrims whom he encountered early in his journey. The Lhasa authorities were fully informed, and the attempt was foredoomed to failure. None the less was it a most instructive journey. It hardly needed the evidence of the distinguished traveller to prove that Tibetans possess civilised and humane instincts. They do not necessarily ill-use a casual visitor to their country who can make himself intelligible and agreeable, but they will not admit the European within the gates of their holy city—if they can help it. We now have more material with which to construct the maps of that dreary, storm-swept, inhospitable waste which lies between the Altyn Tagh and the oasis of the Sanpo (Brahmaputra). The identification of the ancient bed of the Lop Nor and the site of Lou Lan; the elimination from our maps of the Gobi Mountains and the eastern extension of the Kurruk Range; the detailed survey of the Tarim River and the determination of the levels of the desert surface south of Lop Nor, together with the results of a vast area of geographical research on the north coast of Tibet, are records of which even Sven Hedin may be proud. To the world at large he is already known as a great geographer and an intrepid explorer. Hereafter he will be recognised as a most fascinating writer even by those who care little for geography.

T. H. H.

WATER SUPPLY AND IRRIGATION IN THE UNITED STATES.

FOR the last fourteen years very great attention has been paid by the Geological Department of the Government of the United States to the water resources of the country, and in acquiring trustworthy information as to the same.

There has recently been issued from the Government Press at Washington fifteen volumes of reports, and water supply and irrigation papers, bearing on the yield of the rivers, the various methods adopted for gauging the flow and obtaining sectional measurements, artesian wells and the flow and yield of underground water, the means adopted for storage, the use of water for the supply of towns for irrigation and for power purposes, and the pollution of rivers from sewage and other causes.[1]

The greater part of these reports is taken up with records of the observations of the staff engaged in measuring the rivers in the different States and obtaining information as to water supply, which, although mainly of use to engineers in the United States, might also be interesting and instructive to those engaged in the water supply of this country.

The report No. 76 by Mr. Pressey on the flow of rivers in the vicinity of New York State is of special interest, as it deals in a comprehensive manner with the methods adopted for obtaining trustworthy information as to the yield of rivers, and gives details as to the methods adopted for obtaining the measurements necessary for the purpose.

The author of this report considers that one of the chief resources of the United States consists in its water. The prominent industrial position of several States is due largely to the abundance of available water, and the rivers with their great water power have been in the past, and will continue to be in the future, a perpetual source of wealth. Contrary to what might have been expected, Mr. Pressey is of opinion that there never was a period in the history of the United States when the development of water power has made such strides as recently, the increase in the utilisation of water power for the period 1890–1900 being 30 per cent., or 472,361 horse power. In the State of Maine the developed power increased 60 per cent.

The rivers as water suppliers are also of inestimable value in the arid regions of the coastal States, where without an artificial supply of water there cannot be any vegetation, and where large areas have been reclaimed and made into agricultural land of great fertility by storing and distributing the water over their soils. This subject was shortly dealt with in the notice in NATURE of April 30, 1903, on the irrigation in the Western States of America, and of the report of the Mexico College of Agriculture in NATURE of August 27, 1903.

The Geological Department has for the last fourteen

[1] Copies of these reports may be obtained through Messrs. King and Son, Great Smith Street, Westminster.

years been engaged in ascertaining the value of the rivers as water suppliers and in furnishing information upon which to base estimates of the available supply. The want of this information has frequently led to the most disastrous mistakes in the construction of hydraulic works. From ignorance of the hydrographic condition of the drainage basin of the stream, and of the region in which the stream is located, engineers have in many cases been misled by the only information available, that of the "oldest inhabitant," which may be trustworthy as to the highest level to which the water has reached in floods, but is frequently very misleading as to the low water conditions of the river. Amongst other instances recorded is one where, after an expenditure of 32,000*l.* in hydraulic works by a town where it was expected the water from a neighbouring river would be capable of developing 14,000 horse power and cause it to become a manufacturing centre, it was found that the estimate had been based upon a miscalculation as to what the river could yield to the extent of 500 per cent.

Even where statistics as to the rainfall are available, these may be very misleading so far as the yield of the drainage area is concerned unless checked by stream measurements. An instance is quoted where a calculation of the minimum yield of a river in one of the States was made independently by five experienced engineers, the quantity varying from 0·20 to 0·40 cubic foot per second per square mile.

The various forms of floats used to determine the velocity of streams are discussed in the report. For reconnaissance works surface floats have been found most convenient and approximately trustworthy. Rod floats consisting of cylindrical tubes or wooden rods 2 to 3 inches in diameter, weighted at the bottom, are considered as more trustworthy than double floats having the subsurface float connected to the upper one by a silk cord.

The current meter, on the whole, has been found to be best adapted to the general measurements made in the United States Survey. One method of using this

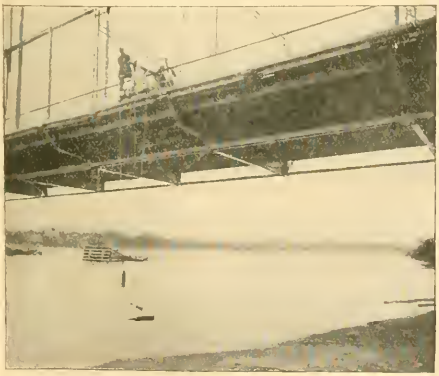

FIG. 1.—Current Meter in Use, Suspended from a Bridge.

in a wide channel is shown in the illustration (Fig. 1). In the second illustration (Fig. 2) the measurements are shown as being taken from a cable having 200 feet span placed across the stream, and supported on the right bank by timber shears 25 feet high, and on the left side anchored to a large buried oak.

As the result of a great number of observations it has been found by the United States surveyors that the mean velocity of a stream is generally found to be at six-tenths of the depth of the water measured from the surface for wide shallow rivers, which figure should be increased to two-thirds in the case of canals and flumes or narrow natural channels. The velocity generally increases from the surface downward to

FIG. 2.—Cable and Car used to Measure Discharge of River.

about one-tenth of the depth, and then decreases to the bottom, where it reaches the minimum.

Where more than one observation was made upon the channel, the ratio between the surface and mean velocities in a stream was found, on the average of a number of experiments in different rivers, to be 0·88 of the mean of the surface velocities taken in the vertical in which the floats were run. Where only one surface float was used in the centre of the river, the coefficient was on an average found to be 0·80. The chances of error are greater where only one float is used. For shallow depths of from 3 to 8 feet the coefficient for the mean velocity varied from 0·92 to 0·82. For large deep rivers, such as the Mississippi, Humphrey's and Abbot's observations gave a coefficient of 0·98.

Measurements are also recorded of the flow of water under ice. The observations were made by cutting holes large enough to admit a current meter. In an ice-covered channel a decided drag occurs at the surface as well as at the bottom. Two points of mean velocity were found to exist in the vertical at about 0·13 and 0·73 of the depth, the maximum being at 0·35 of the depth. The best result was obtained by holding the current meter at two-thirds of the depth and applying a coefficient of 0·95 to the observed velocity at that point.

For providing uniformity in the reports of the various observers as to the quality of the water, the following standard of turbidity was used for field observations. The figure 100 was taken to represent a water containing 100 parts of silica per million, in such a state of fineness that a bright platinum wire one millimetre in diameter can just be visible when the centre of the wire is 100 millimetres below the surface of the water, the eye of the observer being 1·20 metres above the wire, the observation being made in the middle of the day, in the open air, but not in sunlight.

For taking observations a graduated rod with a platinum wire projecting from it at right angles was

used (Fig. 3), on which the graduation mark of 100 is placed on the head at a distance of 100 millimetres from the centre of the wire. When this rod is immersed in water the visibility of the projecting wire at the depth from the surface determines the degree of turbidity according to a scale given in the report. This varies from a turbidity of 7 degrees at a depth of 1095 millimetres to 100 degrees at 100 millimetres depth, 1000 degrees at 21 millimetres, and 3000 degrees at 12 millimetres. When platinum wire is not easily obtainable a clean bright pin will serve the purpose, and where observations cannot readily be made in the stream, a pail or tub filled with the water may be used, the diameter of which should be twice the depth at which the wire is immersed. Where the turbidity is more than 500, that is, where the wire cannot be seen through an inch of water, the water to be gauged should be diluted with clean water, the turbidity being multiplied by the ratio that the total volume of water bears to the water in the mixture.

In report No. 67, on the motion of underground water, by Mr. S. Slichter, it is stated that the lowest theoretical limit at which ground waters can exist is reached when the pressure in the rocks, due to the weight of the superincumbent material, is so enormous

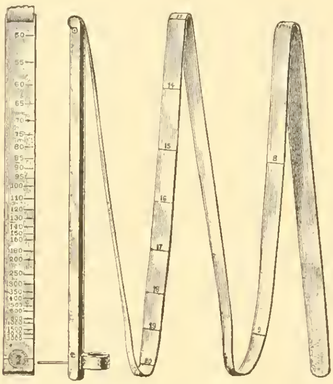

FIG. 3.—Folding Turbidity Stick.

that all cavities and pores are completely closed. This limit, it is calculated, is reached at 6 miles. The land surface of the globe covers 52,000,000, and the water surface 144,700,000 square miles. Taking the average pore space of the surface rocks occupied by water or moisture at 10 per cent., the amount of ground water is estimated at 565,000 million million cubic yards.

On this basis the underground water would be sufficient to cover the entire surface of the earth to a uniform depth of from 3000 to 3500 feet. The ground water is estimated to be about one-third the amount of the oceanic water.

The rate of movement of water through soil and rocks depends on the size of the pores of the water-bearing medium and the pressure gradient or head due to gravity. All rocks are more or less pervious to water. The porosity of quartz sand varies from 30 to 40 per cent. of the bulk. Sandstone rocks fit for building purposes contain from 5 to 25 per cent. of porosity, limestone from 1 to 13 per cent., while granite has about one-half per cent.

The water contained in porous soils and rocks possesses a slow but definite motion, and moves in an underground current for the same reason that water moves in surface streams, flowing from a higher to a lower level.

The flow varies as the square of the size of the grains of soil, and so if the size of the soil grain be doubled, the flow of water is quadrupled.

American experience agrees with the result arrived at by French engineers that the average velocity through sands is about a mile a year.

The general trend of moving underground water under the influence of gravity is into the neighbouring streams and lakes, but the geological conditions may be such as to force the water above the surface of the ground and form springs, or it may take a general course down the thalweg and towards the sea within the porous medium itself, and so constitute an underground stream at great depth and several miles in breadth.

THE WORK OF THE REICHSANSTALT.[1]

THE third volume of the *Transactions* of the Reichsanstalt was noticed in these pages some two and a half years ago. The part under review at present gives an account of the larger researches which have gone on since that date, and affords ample proof of the fact that the staff of the institution has no intention of departing from the high standard of accuracy and excellence we have learnt to expect in their work.

As in the previous volume, the first paper deals with the work of the director of the second division, Dr. Thiessen, who has continued his researches into the dilatation of solids and liquids, and has determined the dilatation of water from 50° C. to 100° C., thus completing his study from its freezing point to its boiling point.

The range from 0° C. to 40° C. had been covered by Chappuis, and the small differences between his results and those of Thiessen were noted in our former article (NATURE, April 25, 1901).

The method of balancing columns employed in the earlier research was used again, the water in the column at high temperature being in each case jacketed by a tube containing the vapour of some liquid boiling at that temperature. Dr. Thiessen shows that above 25° the following formula represents the results with considerable accuracy:—

$$\rho = 1 - \frac{(t - 3{\cdot}98)^2}{568290} \cdot \frac{t + 343}{t + 72{\cdot}75},$$

while, to continue the table given in our previous article, the actual densities found were the following:—

Temperature	Density
56°	0·985243
65°	0·980594
78°	0·973068
100°	0·958380

Another paper which brings earlier work up to date is that by Jaeger and Dieselhorst on the mercury standard of resistance. In consequence mainly of difficulties arising from electric traction, the method of comparing the resistances of the tubes by the use of the differential galvanometer has been abandoned, the Kelvin double bridge being used in its stead.

Calling M the mean of the resistances of four manganin coils of about one ohm resistance, we have the following series of values:

Nov. 1893	M = 1·001737	ohms at 18° C.
June 1895	M = 37	,, ,,
June 1897	M = 44	,, ,,
March 1903	M = 48	,, ,,

[1] "Wissenschaftliche Abhandlungen der Physikalisch-Technischen Reichsanstalt," vol. iv. part i.

The greatest difference between the value of M determined by observation on any one tube and the mean is 15·5 parts in one million, while the greatest change that has taken place in the value of any one of the manganin standards of the first division relative to the tubes is 45 parts in one million.

Dr. Scheel has an interesting paper on the expansion of solids, describing a series of experiments using the Pulfrich form of the Fizeau dilatometer. The method leads to results of great accuracy for expansions at temperatures up to that of the boiling point of water; it is interesting to note that for Berlin porcelain, the expansion of which is of importance in connection with its use in the air thermometer, the author confirms the result of Chappuis and Harker. Holborn and Gruneisen had found that at high temperatures, say 600° C., the expansion is much less than would be inferred from a formula extending over a range from 0° C. to 100° C. In this respect the porcelain resembles fused quartz.

In another paper Lummer and Gehrcke discuss in a very complete manner the optical properties of dispersion apparatus of high resolving power, while reference must be made to two papers, on the scattering of particles from heated metallic surfaces, especially those of the platinum group, and on the scattering of particles from kathode surfaces in a vacuum.

It is clear from this brief notice that the range covered is a wide one, and that the Reichsanstalt is still continuing to advance our knowledge in a notable degree.

RECENT GEOLOGICAL OBSERVATIONS IN CAPE COLONY.[1]

WHEN Dr. Edward Brown, in 1669, carried the fame of the Royal Society across Europe, and quietly pursued his antiquarian inquiries, he remarked that there were "Wars at that time when I was in this Country, between the Elector Palatine and the Duke of Lorrain." In a similar spirit, the geologists of the Cape Commission have continued their conscientious work in a land divided and subdivided against itself, merely transferring their activity to the Transkeian Territories, when geological observation became incompatible "with the necessities of Martial Law" (1901 report, p. 4). The course of a struggle which at one time threatened the Empire is referred to as "the military problem"; the serene permanence of scientific work has seldom been more aptly illustrated.

The region to which the assistant geologists were temporarily exiled lay on the south-east coast of Cape Colony, between the Great Kei River and the frontier of Natal, in native territories where military rule was not proclaimed. In the spring of 1901, however, observations had been rendered possible nearer headquarters, in the divisions of Swellendam and Riversdale. These led to some corrections of the map issued in 1897. Messrs. Rogers and Schwarz point out how the possibly Cretaceous Uitenhage series can often be distinguished from the overlying gravels only by the occurrence of fragments of a quartzite in the latter. This quartzite is a well marked rock that caps the Uitenhage series unconformably.

The same authors, who then formed the field-staff of the survey, describe the general features of the lands examined beyond the Skei. Unlike the western portion of the Colony, there are here no folded mountains near the coast, and the moisture-laden air from the sea penetrates in consequence far inland. The rivers come down from the Storm Bergen and Drakensberg ranges, and cut steep valleys through the vast steps formed by successively elevated "coastal plains." From the coast inwards, we may move along the edge of the same stratum, on the line of strike of a great synclinal. Starting from its axis, about the mouth of the Kei River, older and older beds are met with as we go north-east. In Kentani, the first division, the igneous intrusive masses are so abundant as to obscure the stratified deposits of Karroo age, and seem (p. 31) to have eaten up the latter in making a place for themselves in the crust. The variations from dolerite to granite appear to have originated in a single magma. On nearing Pondoland, the Dwyka Conglomerate, of Lower Karroo age, and always important as a lithological horizon, occurs with its characteristic glaciated boulders. The Table Mountain Sandstone of the Cape system comes out uncrumpled from beneath it. The most interesting work done in Pondoland was the more detailed examination of the Cretaceous beds, already brought to notice by Baily and Garden in 1855, and by Griesbach in 1871. The lower layers contain rolled chelonian bones, and were deposited in shallow water. Among the "superficial," or post-Cretaceous, beds of Kentani is (p. 66) a fossiliferous quartzite of fresh-water origin.

The report for 1902 sees Mr. Rogers installed as acting or chief geologist in place of Dr. Corstorphine, who has been tempted northwards. Mr. A. L. du Toit, himself a colonial, as we are happy to observe, joins the staff as an assistant. The main work for 1902 lay in Matatiele, up against the Drakensberg Range, and still in native territories. The intimate connection of volcanic energy with the range is shown by the discovery of a chain of nineteen vents, in addition to five recorded to the south-west by Mr. Dunn as far back as 1878. They are filled with dolerite or agglomerate, the latter consisting largely of blown-up sedimentary material. The lavas that flowed from them, in Jurassic times, over the upper beds of the Karroo system, have been weathered away on the south-east, but are preserved upon the north-west slope. Mr. Schwarz points out (report for 1902, pp. 51 and 60) how the trend of the volcanic line is related to persistent north-east and south-west axes of folding, which have determined in the past the coast-line of this part of Africa. The old eastern continent had receded, by Jurassic times, as far as the line of volcanic vents; a later uplift must have been followed by subsidence, whereby the present Transkeian coast-line was determined. The edge of the Drakensberg plateau may thus be regarded as the crest of a uniclinal fold, the native territories lying on the lower limb.

The strata encountered range down from the "Cave Sandstone," which may be partly of explosive origin, to permo-Carboniferous beds. All these are included in the convenient but too comprehensive Karroo system (p. 103), though the upper zones may be as modern as the Jurassic period. Indications of reptilian remains are already known (p. 32). The "Molteno beds," more recent than the famous Theriodont horizons of the Karroo system, contain thin coals and oil shales. The natives at present use ox-droppings for fuel, and thus deprive the poor soil of a valuable fertilising agent.

Work was also done in the typical Karroo district, south of the Nieuweveld escarpment, where new discoveries of Pareiasaurus have resulted. Considerable pains have been taken to place the collections of the Commission in the hands of specialists for determin-

[1] Cape of Good Hope. Department of Agriculture. Annual Reports of the Geological Commission for 1901 and 1902. (Cape Town: *Cape Times* Ltd., Government Printers, 1902 and 1903 respectively.)

ation, and no one who has seen the development of the reptilian material from its matrix under the care of Prof. H. G. Seeley can regret that certain specimens, at any rate, have travelled across the sea to England. G. A. J. C.

THE CLIMATE OF SOUTH AMERICA.[1]

IN the volume mentioned below, all the mean values of the meteorological elements which constitute the climate of the country in question are brought together, these values being deduced from a long series of observations terminating with the year 1900. When it is mentioned that the country embraces 33° of latitude, the surface of which slopes from the shores of the Atlantic on the east to the snow-clad summits of the central range of the Andes on the west, the reader must not be surprised if he finds great differences in the atmospheric conditions that prevail in the various parts of the Republic.

A thorough knowledge of the changes in the meteorological elements in this the South American portion of the globe will prove of great importance to us dwellers in the Old World, for although we are separated so widely as regards distance, we are intimately connected meteorologically. It is quite within the bounds of possibility that our great dependency India and the region about it (and indirectly the British Isles and Europe generally) may be able to check their long period forecasts on observations made in the Argentine Republic.

In this volume an English translation accompanies the Spanish text, so that the book is available to those who cannot read the latter language. In addition to the numerous tables showing the mean daily and annual variations of the elements, accompanied by an excellent statement in each case, Prof. Davis has given a set of twenty-six plates which illustrate graphically not only these variations, but the mean conditions which prevail over this extensive area.

For many of the elements the monthly and yearly values for each year since the commencement of observation are included, but an omission is made in the case of atmospheric pressure. Recent investigations have indicated that the variations from year to year over the South American continent, more especially about the region of Cordoba, are the inverse of those about the region surrounding the Indian Ocean, that is, when the mean pressure for the year is high in Cordoba it is low in India; the insertion of the pressure values in this volume for one station, namely, Cordoba, would have been very useful.

For climatological reasons it is necessary to study the readings of many barometers well scattered over a country, hence the statement on p. 45 that "observations of atmospheric pressure, however complete, are of little practical value if confined to a single place. . . ." It is important, however, to bear in mind that complete series of barometric observations at two stations, one set to check the other, are quite sufficient in many parts of the world to study the changes over large areas from year to year.

The publication of this volume will undoubtedly be welcomed by meteorologists and those who wish to make themselves acquainted with the weather of the region surveyed, and the very complete manner in which the information has been brought together in this convenient form should add to its usefulness.

W. J. S. L.

[1] "Climate of the Argentine Republic." Compiled from Observations made to the end of the Year 1900. By Walter G. Davis, Director of the Argentine Meteorological Office. Pp 154; 26 plates. (Published by the Ministry of Agriculture.)

NOTES.

A CIRCULAR signed by Prof. A. Tonelli and Prof. V. Cerruti announces that it is proposed to erect a memorial in honour of the late Prof. Luigi Cremona, professor of higher geometry in the University of Rome, and director of the engineering school. The fame of Prof. Cremona is world-wide, and his works have exercised a great influence on research in fields of pure and applied mathematics. It is intended that the monument to his memory shall be an international one; and the hope is expressed that all who have been inspired by his discoveries, or have regard for his genius, will contribute to the fund being raised. Subscriptions should be sent to Signor I. Sonzogno, Piazza San Pietro in Vincoli, 5, Rome.

AT a meeting of the Bath Town Council on Tuesday, mention was made of the fact that helium has been found in gases from the largest and perhaps the best known of the city's hot mineral springs, the King's Bath. The deposits that collect in the tanks and pipes at the three springs have also been investigated. A few weeks ago a quantity of the deposit from the new Royal spring was obtained and sent to the Hon. R. J. Strutt, who, in a communication to the Baths Committee, remarks:—"My experiments have led to some conclusions which may, I hope, interest the committee. I have found that the deposit contains radium in appreciable quantities, though I am sorry to say not enough to pay for extraction. It will be remembered that the gas which bubbles up from the springs contains a small proportion of helium. Sir William Ramsay has recently made the most important discovery that radium slowly evolves helium by a spontaneous change. I think there can be little doubt that the helium of Bath owes its origin to large quantities of radium at a great depth below the earth's surface. A little of this radium is carried up by the rush of hot water and is found in the deposit. My experiments promise further interesting developments, which I shall have much pleasure in bringing to the notice of the committee in due course."

A MEETING was held in the house of the Zoological Society on Tuesday to consider proposals for the organisation of zoologists. Forty-one zoologists from England, Scotland and Ireland attended the meeting. The following resolution was carried by a large majority:—"That it is desirable that the zoologists of Great Britain and Ireland be organised for the consideration of all matters affecting the interests of zoology and zoologists, and to take such action as may seem desirable." A committee consisting of Prof. Cossar Ewart, Prof. Bridge, Prof. Hickson, Dr. Scharff, Dr. G. C. Bourne, Dr. Ridewood, and Mr. Cunningham was appointed to draw up a scheme.

WE are glad to see among the New Year honours gazetted by the India Office the name of Dr. W. T. Blanford, F.R.S., who has been made a Companion of the Order of the Indian Empire. Dr. Blanford, whose services to Indian geology and zoology are known to all our readers, joined the Geological Survey shortly before the outbreak of the mutiny, and is one of the few civilians entitled to wear a Mutiny medal.

ON New Year's Day we had the pleasure of inspecting a series of the well-known animal photographs of the Messrs. Kearton now being exhibited to the public at 175 Bond Street. All these reproductions from the original photographs have been considerably enlarged, although not to such an extent as to impair the sharpness or blur the

details. The owners are to be congratulated, not only on the general character of the exhibition, but likewise on the fact that none of the photos have been "touched up." Mr. Cherry Kearton specially prides himself on the photo of a great crested grebe on her nest, which took seven days' watching before it could be secured.

SIR WILLIAM RAMSAY, K.C.B., will, we learn from *Science*, give a course of lectures during the summer session at the University of California on "The Constituents of the Atmosphere and the Emanations from Radium."

THE year 1905 being the tenth anniversary of Röntgen's discovery of the X-rays, it is proposed to commemorate the occasion by holding in Berlin a Röntgen congress, together with a Röntgen exhibition. Information regarding the arrangements will be obtainable from Prof. R. Eberlein or Dr. Immelmann, of Berlin.

A SPECIAL meeting of the Berlin Geographical Society will be held on January 13 to greet the members of the German Antarctic Expedition and receive the report of Prof. E. von Drygalski on the course and results of the expedition. An address will be given by Prof. Vanhöffen on the fauna of south polar regions.

ON Tuesday next, January 12, Prof. L. C. Miall will commence a course of six lectures at the Royal Institution on the "Development and Transformations of Animals." On Thursday, January 14, Mr. G. R. M. Murray will deliver the first of three lectures on the "Flora of the Ocean," and on Saturday, January 16, Mr. J. A. Fuller-Maitland will begin a course of three lectures on "British Folk-Song." The Friday evening discourse on January 15 will be delivered by the Right Hon. Lord Rayleigh, his subject being "Shadows"; on January 22 by the Rev. W. Sidgreaves, on "Spectroscopic Studies of Astrophysical Problems at Stonyhurst College Observatory"; and on January 29 by Mr. D. G. Hogarth, on "The Marshes of the Nile Delta."

CAPTAINS S. P. JAMES AND W. GLEN LISTON, of the Indian Medical Service, write from Simla to point out that the third volume of Mr. F. V. Theobald's work on the Culicidæ contains reproductions of portions of plates which they have prepared for a monograph on Indian Anopheles, and that statements are made in a number of cases without reference to the work of the individual observers upon whose results they are based. We have referred the matter to Mr. Theobald, who writes:—"I much regret that the plates and information to which they refer should have been published without acknowledgment in my book. The omission was due entirely to inadvertence, occasioned by the press of matter calling for record in the work. Steps are being taken to remedy the error."

WE learn from *Science* that the following Bill has been introduced into the U.S. House of Representatives and referred to the committee on coinage, weights and measures:—"*Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled*, That on and after the first day of January, nineteen hundred and five, all the Departments of the Government of the United States, in the transaction of all business requiring the use of weight and measurement, except in completing the survey of public lands, shall employ and use only the weights and measures of the metric system; and on and after the first day of January, nineteen hundred and six, the weights and measures of the metric system shall be the legal standard weights and measures of and in the United States."

THE Australian mail has brought the report of the meeting of the Linnean Society of New South Wales on November 25 last, from which we learn that the chairman made a preliminary announcement respecting the Macleay fellowships endowment—the late Sir William Macleay's last and crowning benefaction to science. Subject to a life-interest in the principal on the part of his widow, lately deceased, Sir William bequeathed to the Society the sum of 35,000*l*. for the foundation and endowment of research fellowships, tenable by graduates in science of the University of Sydney upon certain conditions specified in the testamentary directions. On October 24, 1903, the executors paid to the Society the sum of 33,250*l*., which the council has since invested at 4 per cent. per annum. The council does not expect to be in a position to make appointments to the fellowships before about the middle of this year.

THE *Times* publishes the following communication from its Madrid correspondent:—"In anticipation of the total eclipse of the sun of August, 1905, the papers are beginning to urge the Government to include in the Estimates for 1904 an item providing for a scientific mission of Spanish astronomers to be sent abroad, in order to study in foreign observatories the latest methods of investigating the phenomenon. For the eclipse of 1900 the Cortes voted 190,000 pesetas, but the measure was taken so late that the money was spent at a loss. It may be mentioned that the zone of about 200 kilometres covered by the eclipse of 1905 traverses Spain from Galicia and Asturias to Valencia and Castellon. The northern coast between Coruña and San Vicente de la Barquera, and the eastern from Valencia to the Gulf of San Jorge will be included in the zone of total obscurity. Observers at Ferrol, Lugo, Oviédo, Gijon, Léon, Palencia, Burgos, Soria, Teruel, and Saragossa will have some four minutes in which to make their observations. Madrid lies to the south of the zone of total eclipse. It would be well if foreign astronomers would lend their sympathy to Spanish students to facilitate the preparations for the most effective utilisation of these precious moments."

WITH the daily weather report for January 1 the Meteorological Office issued a small subsidiary chart showing the total rainfall in 1903 at those stations which report by telegraph, together with the percentages of the average annual fall for the thirty-five years 1866–1900. The chart shows very clearly the general distribution of the rainfall of the year, so far as it is represented by the stations referred to. The greatest fall, 67 inches, occurred at Valencia, 120 per cent. of the yearly average. At Stornoway the amount was 62 inches, 133 per cent. of the average (46·62 inches), this latter value being nearly 10 inches less than the normal fall at Valencia. The smallest falls occurred on the east and south-east coasts of England; at Yarmouth the rainfall was only 24·83 inches, 95 per cent. of the average (26·40 inches). The greatest percentage *excess* was registered in London, the aggregate amount being 38 inches, 156 per cent. of the average annual fall, and at Oxford the rainfall amounted to 142 per cent. of the average. At Greenwich (not shown on the chart) the rainfall for the year was 35·58 inches, being 11·43 inches above the average for sixty years; there were 184 rainy days. The previous largest fall there in this period was 34·01 inches in the year 1852.

SOME of the smaller shell-fish, especially cockles, have recently been found to be grossly contaminated with sewage. These fish form a staple article of diet among the poorer classes, and since they are cooked before consumption, it might be thought that the bacillus of typhoid fever would

be destroyed and the molluscs rendered harmless thereby; but this cooking is a very perfunctory process, and consists in plunging netfuls of the live fish, the shells of which are tightly closed, into a vessel containing boiling water. The immersion of the cold mass immediately lowers the temperature, and when, in the course of two or three minutes, the water begins to boil again, the nets are lifted out. The scalding kills the fish and causes the shells to open, but does not sterilise the contents, and fish that had been kept in typhoid polluted water were found to be swarming with live bacilli after this process of cooking. Prolonged boiling would be effective, but causes the fish to shrivel and spoils them for sale. Dr. Klein suggested that cooking by steam might be found to sterilise efficiently without spoiling the fish as food, and some experiments have recently been carried out for the Fishmongers' Company with a view to test this. Two batches of molluscs were cooked, one for ten minutes and the other for five. The steamer used was a vessel two feet deep, the fish being distributed in three layers on trays, the steam being introduced by a pipe about an inch from the bottom. The results were: ten minutes, mussels spoilt and useless, cockles all right in upper layer, bottom layer overcooked; five minutes, mussels all right, and also two upper layers of cockles, but bottom layer of cockles less satisfactory. The bacterial results were that the cockles proved to be sterile in all cases. The mussels were also sterile, except some in the top layer steamed for five minutes, which still contained some living spores. As a result of these experiments the Fishmongers' Company feels justified in strongly recommending a substitution of steaming for boiling to the trade.

DISCUSSING the subject of nuclear division without cell division, Mr. Ralph Lillie suggests that mitosis is an incidental consequence of the passage of the chromatin into the strongly acid and chromatic phase. This change, he believes, involves the acquisition by the chromatin of a negative charge of considerable potential, as a result of the inductive action of which there ensues a redistribution of the ions in the cytoplasm with the production of certain differences of electrical potential. To these potential differences are due the appearance of the astral radiations and the diminution of surface tension that leads to cleavage (*Biological Bulletin*, vol. iv. No. 4).

IN a paper in the *Technology Quarterly* (vol. xvi. No. 3) Messrs. C. E. A. Winslow and C. P. Nibecker discuss the significance of bacteriological methods in sanitary water analysis. They consider that the real application of chemistry begins where that of bacteriology ends. When pollution is so gross that its existence is obvious and only its amount need be determined, the bacteriological tests will not serve on account of their excessive delicacy. In studying the gross pollution of streams, treatment of trades' wastes, and purification of sewage, the relations of nitrogenous and oxygen compounds are of prime importance, that is, when pollution is to be avoided because the decomposition of chemical substances causes a nuisance, it must be studied by chemical methods. When the danger is that of infection, and arises only from the presence of bacteria, bacteriological methods furnish the best index of pollution. With regard to methods, the authors express a preference for the use of the fermentation tubes, and of gelatin, and of lactose agar, plates.

THE secretary of the Durham College of Science, Newcastle-upon-Tyne, writes to supplement the remarks respecting the conditions on which women can obtain degrees in the University of Durham, contained in an article on the higher education of women published in our issue of December 24, 1903. Residence in Durham is necessary only for women proposing to take a degree in arts of the Durham University; for Durham degrees in science, medicine, &c., attendance at the Durham College of Science and the University of Durham College of Medicine is the qualification, and there are many women undergraduates at these colleges in Newcastle-upon-Tyne.

IN the December number of the *Zoologist* Mr. A. H. Cocks discusses the length of the period of gestation in the badger, which he is inclined to think is nearer a twelvemonth than the four and a half months assigned to it by Mr. Meade-Waldo.

THE homology and classification of the tines developed in the crown of the antlers of the Carpathian red deer form the subject of an article by Dr. E. Botezat in Gegenbaur's *Morphologisches Jahrbuch* (vol. xxxii. part i.). In an appendix the author records the existence of what he regards as two local races of the species, for which the names *Cervus vulgaris campestris* and *C. v. montanus* are proposed. It may be pointed out, in the first place, that *C. vulgaris* is not the name of the red deer, and, in the second place, that *C. v. campestris* is preoccupied by *C. campestris*, one of the names of the South American pampas deer.

Bulletin No. 41 of the entomological division of the U.S. Department of Agriculture is devoted to an account of the life-history of the codling-moth and the damage inflicted by its caterpillar on orchards. The author, Mr. C. B. Simpson, states that this now cosmopolitan insect was introduced into the North-west Pacific States about the year 1880. On account of the genial climate of this new habitat two overlapping annual broods are now produced, and if proper preventive measures are not taken to keep them in check, the entire apple-crop in many districts is liable to damage. The best remedial measures appear to be arsenical spraying and banding, and by these means the damage to the crop in one case has been reduced from between 40 and 60 per cent. to as low as 10 per cent., while it is estimated that by continuing the process for a few years the injury inflicted by this insect might in any locality be reduced from nearly 100 per cent. to 5 or 10 per cent. The annual shrinkage in value of American apple-crops owing to the ravages of this moth has been estimated at 11,000,000 dollars.

THE seas of Japan, Okhotsk, and Bering have been attracting of late a great deal of attention from both Russian and American explorers. M. P. Schmidt gives now, in a recent issue of the *Izvestia* of the Russian Geographical Society (1903, ii.), a short sketch of the physical geography of these seas, with a list of 133 species of fishes found in them, and their distribution, the list being based both on previous research and the author's own collection, which contains 100 species.

THE hydrographic expedition of M. L. S. Berg, which has collected interesting data concerning the present rise of level of Lake Aral, has also studied the temperature, the currents of the lake and its salinity (specific gravity from 1.0076 to 1.0080 in the middle parts, and up to 1.0084 and 1.0090, occasionally 1.0094 in sheltered bays). The plankton is poorer than in European lakes, and during the hot days it keeps at a certain depth, coming to the surface only in the moonlight. M. S. A. Zernoff, who has studied the Aral collections, has found in them quite a number of forms which had only been met with in the Caspian Sea, and had only lately been described by Prof. Sars. The expedition has also collected ants, lizards, and other specimens of interest to naturalists.

The *Century Magazine* for January contains an illustrated article on radium by Prof. E. Merritt, and one on radium and radio-activity by Mme. Curie. The extraction and properties of the new element are also described in the *Strand Magazine*, in the course of an illustrated interview with M. Curie.

The bound volume for 1903 of *Knowledge*, which has now been published, makes a very attractive book. It is profusely illustrated, and, as usual, the astronomical plates are particularly good. The magazine has just been incorporated with the *Illustrated Scientific News*, and the combined journal will be published under the joint title of *Knowledge and Illustrated Scientific News*.

The second part of vol. ii. of "The Fauna and Geography of the Maldive and Laccadive Archipelagoes," being the account of the work carried on and of the collections made by an expedition during the years 1899 and 1900, has been published by the Cambridge University Press. This part, edited by Mr. J. Stanley Gardiner, contains the following three reports:—marine mollusca, by Mr. Edgar A. Smith; the Enteropneusta, by Mr. R. C. Punnett; and marine Crustacea—the spider-crabs (Oxyrhyncha) and the classification and genealogy of the reptant decapods—by Mr. L. A. Borradaile. The third part of vol. ii. is to be published on May 15.

We have received the second series of vol. viii. of the "Proceedings and Transactions of the Royal Society of Canada," and notice that it contains a full account of the twenty-first general meeting held at Toronto in May, 1902. The presidential address, by Sir James A. Grant, K.C.M.G., had for its subject the universities in relation to research, and constitutes the first appendix to the first part of the volume, which includes the *Proceedings*. The second appendix contains reports from twenty-seven associated literary and scientific societies in Canada, some of the reports being in French. Similarly the section of the *Transactions* dealing with French literature, history, and archæology is given in French. Among papers read before the section concerned with the mathematical, physical, and chemical sciences may be mentioned:—On the stresses developed in beams loaded transversely, by Prof. H. T. Bovey, F.R.S.; researches in physical chemistry carried out in the University of Toronto during 1901–2, by Prof. W. L. Miller; on the existence of bodies smaller than atoms, by Prof. Rutherford; on the absolute value of the mechanical equivalent of heat, by Prof. H. T. Barnes; and the specific heats of organic liquids and their heats of solutions in organic solvents, by Dr. J. W. Walker and Dr. J. Henderson. In the section of the geological and biological sciences twelve papers are included, and among them are two by Prof. D. P. Penhallow on *Osmundites skidegatensis* and notes on Cretaceous and Tertiary plants of Canada. Dr. G. F. Matthew contributes notes on Cambrian faunas, and Prof. A. P. Coleman discusses the classification of the Archæan. The volume contains numerous well executed illustrations, and is an excellent witness to the value of the work in science which is being accomplished in Canada.

The determination of the density of chlorine gas is attended with many experimental difficulties, and the figures obtained by different workers vary between 2·448 and 2·491. In the current number of the *Comptes rendus* MM. H. Moissan and Binet du Jassoneix describe their researches on this subject. Three groups of experiments are given, involving seventeen determinations, and the final figure regarded as the most probable is 2·490 at 0° C., a value identical with the figure of Leduc. The chief sources of error to be eliminated are the presence of air in the density flask, the difficulty of completely drying the gas, and the solubility of different gases in liquefied chlorine.

In a recent number of the *Comptes rendus* it is stated by M. Becquerel that when crystals of hexagonal zinc blende are crushed between glass plates they emit a flash of light comparable with that which is produced by the proximity of a radium salt in Crookes's spinthariscope. It is suggested that in the latter case the positively charged α-particles fracture by their impact the surface of the blende, and that the flashes of light observed are thus caused by a mechanical action on the screen.

The origin of natural asphalte or bitumen has given rise to much speculation, and the suggestion has been made that it is produced by the destructive distillation of vegetable remains mixed with organic matter, and especially with fish. Another possible explanation is suggested by the production of an artificial asphalte by heating natural petroleum with sulphur. The series of paraffins is not affected by this treatment, but the naphthenes which are present in the petroleum undergo condensation and give rise to bodies which may be regarded as typical constituents of asphalte. Two of these, prepared by the action of sulphur on acenaphthene, $C_{10}H_6\langle\begin{smallmatrix}CH_2\\ |\\ CH_2\end{smallmatrix}$, have recently been described by Karl Dziewoński in the *Berichte*. The first is a hydrocarbon, $C_{36}H_{18}$ (trinaphthylene benzene), melting at 387° C., which contains no less than ten independent ring systems, and is therefore named decacyclene, whilst the second is a sulphur-compound, $C_{24}H_{12}S$ (dinaphthylenethiophen), melting at 278° C.

The additions to the Zoological Society's Gardens during the past week include a Mozambique Monkey (*Cercopithecus pygerythrus*) from East Africa, presented by Lady Amherst; a Patas Monkey (*Cercopithecus patas*) from West Africa, presented by Mr. F. A. Knowles; a Lesser White-nosed Monkey (*Cercopithecus petaurista*) from West Africa, presented by Mr. G. A. Hanton; a Black-backed Jackal (*Canis mesomelas*) from South Africa, presented by Captain Moseley; a Hairy-rumped Agouti (*Dasyprocta prymnolopha*) from Central America, presented by Mr. John Gordon; two Ring-tailed Coatis (*Nasua rufa*) from South America, presented respectively by Mr. H. Everest and Mr. D. F. Mackenzie; a Water Rail (*Rallus aquaticus*), British, presented by Mr. F. W. Pizzey; a Californian Sea Lion (*Otaria californiana*) from the North Pacific Ocean, seven Indian Fruit Bats (*Pteropus medius*) from India, deposited.

OUR ASTRONOMICAL COLUMN.

Astronomical Calendars for 1904.—The "Annuaire du Bureau des Longitudes" for 1904 contains more than 700 pages of useful tables and formulæ, astronomical and physical, including lucid explanations of such matters as the several different calendars, the tides, &c. A new arrangement is inaugurated in this year's publication; instead of giving the customary complete set of tables, &c., only those relating to astronomy, physics, and chemistry are included, and it is proposed to omit the chemistry and physics next year, giving instead full sets of tables relating to general geography, meteorology, and statistics. This alternation will be continued in future "Annuaires."

The "Annuaire astronomique et météorologique," compiled by M. Camille Flammarion, attains its fortieth year of publication in the issue for 1904. It gives a complete account of the astronomical occurrences due this year, and a useful review of the astronomical and meteorological

phenomena of recent years. The current issue contains many illustrations, among which are some good reproductions of photographs and drawings of sun-spots, comets, and planetary features observed during 1903. The charts of the sky and the particulars of interesting phenomena, which are given for each month, will be found very useful by all who are engaged in practical astronomy. The "Annuaire" is published by M. Ernest Flammarion, 26 Rue Racine, Paris, at 1.50 francs (about 1s. 3d.).

The card calendar issued by Mr. Arthur Mee, of Llanishen, under the title "The Heavens at a Glance" contains a very complete set of the tables and a great deal of the information required by an amateur practical astronomer. Being printed on a single stiff card, suitable for hanging on the observatory wall, it is exceedingly handy to use as a source of reference for current astronomical occurrences. Amongst other information the card contains a list of the principal meteor showers, with concise instructions to observers, ephemerides of the planets and lists of double stars, variables and nebulæ. It may be obtained from Mr. Mee, at the above address, for 7d. post free.

THE VARIABLE STAR 1921, W AURIGÆ.—In No. 5, vol. xviii., of the *Astrophysical Journal*, Mr. J. A. Parkhurst, of the Yerkes Observatory, gives the details and results of a series of observations of the variable star W Aurigæ, made by him during the period December, 1898–March, 1903. He determined the position of the variable (for 1900) as R.A. = 5h. 20m. 8·6s., $\delta = +36° 48' 53''$, and found that the magnitude varied from 9·3 at maximum to 13·8 at minimum. The strong colour of this variable is indicated by the fact that when the visual magnitude was 9·5 the photographic magnitude was only 10·9.

The variations are best represented, according to the curves which Mr. Parkhurst has plotted from his observations, by the following elements:—

Max. = J.D. 2414648 + 276 E.
or December 24, 1898 + 276 E.,

the interval, M–m, being 113 days.

LIGHT ECONOMY IN SPECTRUM PHOTOGRAPHY.—In a paper communicated to the current number of the *Astrophysical Journal*, Mr. J. A. Humphreys describes a number of arrangements used by him in photographing spectra for utilising to the full the light obtained from the light source under examination. He has found that the most generally convenient and effective arrangement, when terrestrial light sources are being used, is to place a spherical reflector behind the source so that the focus of the reflected light coincides with the origin. In this way both the reflected and direct light are utilised, and are together focused on the slit by an ordinary condenser. Comparison photographs, which are reproduced in the article, show that the light reflected through the source suffers but little from absorption, and that the net result of using this arrangement is to obtain lines which would otherwise be too weak to photograph, and to strengthen the weaker lines.

Another method, which may be used with any source when a grating is used as analyser, is to place a pair of inclined plane reflectors between the slit and the grating so that the rays from the top and bottom of the slit are reflected on to the centre of the grating, thereby condensing the light from the whole length of the slit into a narrower plane, and so obtaining a stronger spectrum. In another, but somewhat similar, form, the two plane reflectors are placed near to the photographic plate, so that the parallel rays from the top and bottom of the grating are superimposed upon the rays from the centre. It is found that when long-focus gratings are used the slight lengthening of the path of the rays by reflection does not interfere, practically, with the definition. Many other arrangements, including the use of ellipsoidal and paraboloidal reflectors and cylindrical lenses, are explained and illustrated in Mr. Humphreys's article.

INTENSITY OF THE SUN'S LIGHT.—M. Ch. Fabry has communicated to the Paris Academy of Sciences an interesting paper on the candle-power of the sun's light at sea-level. By an ingenious arrangement, wherein the total solar light is diminished in a known ratio by passage through a slit and then through an ammoniacal solution of copper sulphate, he compared the light with a constant standard light of known candle-power, and, after various corrections, found that at sea-level, with the sun at the zenith, the solar light would be 100,000 times more intense than that produced by a decimal candle at a distance of 1 metre. Supposing that the intensity of the light emitted by different parts of the apparent solar surface is the same, this result shows that the intensity of the light received—after atmospheric absorption—from 1 square mm. of the solar disc is equivalent to 1800 candle-power, as compared with 150–200 candle-power per square mm. emitted by the positive pole of the electric arc.

Taking the amount of heat received per minute from 1 square cm. of the solar surface as 1·5 calories, M. Fabry calculates that the energy consumed per candle-power is about 0·12 watt, but, as the invisible heat rays suffer more by atmospheric absorption, the actual amount of energy used up is probably between 0·15 and 0·2 watt per candle (*Comptes rendus*, No. 23, vol. cxxxvii.).

PRIZES PROPOSED BY THE PARIS ACADEMY OF SCIENCES FOR 1904.

THE following subjects for prizes are proposed for the year 1904 by the Paris Academy of Sciences:—

In geometry, the grand prize for mathematical science (3000 francs), the subject proposed being to perfect, in some important point, the study of the convergence of continued algebraical fractions; the Bordin prize (3000 francs), to develop and perfect the theory of surfaces applicable to the paraboloid of revolution; the Vaillant prize (4000 francs), to develop and study all displacements of an invariable figure in which different points of the figure describe spherical curves; the Francœur prize (1000 francs) and the Poncelet prize (2000 francs), for discoveries useful to the progress of pure and applied mathematics.

In mechanics, the extraordinary prize of 6000 francs, to recompense progress in the direction of increasing the efficiency of the French naval forces; a Montyon prize (700 francs), for the improvement or invention of instruments useful to the progress of agriculture, or the mechanical arts or sciences; and the Plumey prize (2500 francs), for an improvement or invention relating to steam navigation.

In astronomy, the Lalande prize (540 francs), for the most interesting observation or memoir dealing with astronomy; the Valz prize (460 francs), for the most interesting observation made during the current year; and the Janssen prize, a gold medal, for an important work on physical astronomy.

In geography and navigation, the Binoux prize (2000 francs), for a work dealing with either of these subjects.

In physics, the Hébert prize (1000 francs), for the best treatise or discovery useful in the practical application of electricity; the Hughes prize (2500 francs), for work contributing to the progress of physics; and the Kastner-Boursault prize (2000 francs), for the application of electricity to the arts, industry, or commerce.

In statistics, a Montyon prize (500 francs), for the best study in French statistics.

In chemistry, the Jecker prize (10,000 francs), for work in organic chemistry.

In physical geography, the Gay prize (1500 francs), for a study of the existing variations in the relative levels of land and sea, by means of precise observations, pursued over a fixed portion of the coasts of Europe or North America.

In botany, the Desmazières prize (1600 francs), for a work on the cryptogams; the Montagne prize (1500 francs), for work on the anatomy, physiology, development or description of the lower cryptogams; the de la Fons-Mélicocq prize (900 francs), for the best botanical work dealing with the north of France; and the Thore prize (200 francs), for the best work on the cellular cryptogams of Europe.

In anatomy and zoology, the Savigny prize (1300 francs), for the assistance of young zoologists making a special study of the invertebrates of Egypt and Syria; and the Thore prize (200 francs), for a work on the anatomy of a European species of insect.

In medicine and surgery, a Montyon prize (three prizes of 2500 francs, three mentions of 1500 francs), for discoveries useful in the art of healing; the Barbier prize (2000 francs), for a valuable discovery in the surgical, medical or pharma-

-ceutical sciences, or in botany in relation to medicine; the Bréant prize (100,000 francs), for the discovery of a specific cure for Asiatic cholera, or for the discovery of its cause, such that the epidemic can be suppressed. If neither of these be forthcoming, the interest on the capital sum will be given for a rigorous demonstration of the presence in the air of substances playing a part in the propagation of epidemic diseases. The Godard prize (1000 francs), for a memoir on the anatomy, physiology, or pathology of the genito-urinary organs; the Lallemand prize (1800 francs), for the encouragement of work relating to the nervous system; the Baron Larrey prize (750 francs), for a work on military medicine, surgery or hygiene; the Bellion prize (1400 francs) and the Mège prize (10,000 francs), for an essay on the causes which have retarded or favoured the progress of medicine from antiquity to the present day.

In physiology, a Montyon prize (750 francs), for a work in experimental physiology; the Philipeaux prize (900 francs); the Pourat prize (1000 francs), for a study of the physical and chemical changes in respiration induced by high altitudes; and the Martin-Damourette prize (1400 francs), for a work on therapeutical physiology.

Among the general prizes are the Arago medal; the Lavoisier medal and the Berthelot medal; the Montyon prizes (unhealthy trades, 2500 francs and 1500 francs), for a discovery ameliorating the condition of an unhealthy trade; the Wilde prizes (4000 francs, or two of 2000 francs), for a discovery in astronomy, physics, mineralogy, geology or experimental mechanics; the Tchihatchef prize (3000 francs), for exploration in Asia; the Leconte prize (50,000 francs), for a capital discovery in mathematics, physics, chemistry, natural history or medicine; the Jean-Jacques Berger prize (15,000 francs), for a work on Paris; the Delalande-Guérineau prize (1000 francs); the Jerome Ponti prize (3500 francs); the Houllevique prize (5000 francs); the Cahours prize (3000 francs), for researches in chemistry; the Saintour prize (3000 francs); the Trémont prize (3000 francs); the Gegner prize (3800 francs); and the Lannelongue prize (1200 francs).

Among these, the prizes bearing the names of Lalande, Desmazières, Lavoisier, Wilde, Tchihatchef, and Leconte will be awarded without distinction of nationality.

RESEARCH GRANTS OF THE CARNEGIE INSTITUTION.

A LIST of the grants in aid of scientific investigations made by the Carnegie Institution during the fiscal year 1903 is given below. The amount set apart as grants for research during that period was 40,000*l*. From the beginning of the Institution to the end of October, 1903, the number of applications for grants was 1042, and the total sum asked for by the 406 applicants who stated the amount desired was more than 440,000*l*. In addition, the advisory committees recommended grants amounting to 182,300*l*., so that the total sum asked for was about 622,300*l*. It will be evident from this that the present income of the Carnegie Institution can only provide for a small part of the grants requested. The grants made are as follows:—

Anthropology.—For ethnological investigation among the Pawnees, Dr. G. A. Dorsey, Field Columbian Museum, Chicago, Ill., 500*l*.; for obtaining evidence relative to the early history of man in America, Dr. Wm. H. Holmes, director Bureau of American Ethnology, Washington, D.C., 400*l*.; to investigate the precious stones and minerals used in ancient Babylonia in connection with the investigation of Mr. William Hayes Ward, Mr. George F. Kunz, New York City, 100*l*.; for study of oriental art recorded on seals, &c., from western Asia, Dr. William Hayes Ward, New York City, 300*l*.

Astronomy.—For astronomical observations and computations, Prof. Lewis Boss, Dudley Observatory, Albany, N.Y., 1000*l*.; for investigating proposal for a southern and a solar observatory, Profs. Boss, Hale and Campbell, 1000*l*.; for pay of assistants to take part in researches at the Lick Observatory, Prof. W. W. Campbell, Lick Observatory, Mt. Hamilton, Cal., 800*l*.; for a new reduction of Piazzi's star observations, Prof. Herman S. Davis, Gaithersburg, Md., 100*l*.; for measurements of stellar parallaxes, solar photographs, &c., Prof. George E. Hale, Yerkes Observatory, Williams Bay, Wis., 800*l*.; for determining the elements of the moon's motion and testing the law of gravity, Prof. Simon Newcomb, Washington, D.C., 600*l*.; for study of the astronomical photographs in the collection of Harvard University, Prof. E. C. Pickering, Harvard University, Cambridge, Mass., 500*l*.; for pay of two assistants to observe variable stars, Prof. Wm. M. Reed, Princeton Observatory, Princeton, N.J., 200*l*.; for measurement of astronomical photographs, &c., Miss Mary W. Whitney, Vassar College, Poughkeepsie, N.Y., 200*l*.

Bibliography.—For preparing and publishing the "Index Medicus," Dr. Robert Fletcher, Army Medical Museum, Washington, D.C., 2000*l*.; for preparing and publishing a "Handbook of Learned Societies," Mr. Herbert Putnam, Librarian of Congress, Washington, D.C., 1000*l*.

Botany.—For investigation of plant hybrids, Mr. W. A. Cannon, New York Botanical Garden, N.Y., 100*l*.; for study of types of water-lilies in European herbaria, Mr. H. S. Conard, University of Pennsylvania, Philadelphia, 60*l*.; Desert Botanical Laboratory (Mr. F. V. Coville and Mr. D. T. MacDougal, Washington, D.C.), 1600*l*.; researches on the cytological relations of the Amœbæ, Acrasieæ and Myxomycetes, Mr. E. W. Olive, Crawfordsville, Ind., 200*l*.; for preliminary studies on the Philippine flora, Dr. Janet Perkins, working at the Royal Botanical Gardens, Berlin, Germany, 380*l*.

Chemistry.—For a systematic chemical study of alloys, beginning with the bronzes and brasses, Prof. W. D. Bancroft, Cornell University, Ithaca, N.Y., 100*l*.; for investigation of the rare earths, Prof. L. M. Dennis, Cornell University, Ithaca, N.Y., 200*l*.; for investigations in physical chemistry, Prof. H. C. Jones, Johns Hopkins University, Baltimore, Md., 200*l*.; for researches on osmotic pressure, Prof. H. N. Morse, Johns Hopkins University, Baltimore, Md., 300*l*.; for certain chemical investigations, Prof. A. A. Noyes, Massachusetts Institute of Technology, Boston, Mass., 400*l*.; for investigation of values of atomic weights, &c., Prof. Theo. W. Richards, Harvard University, 500*l*.; for continuing investigations on the derivatives of camphor and allied bodies, Mr. J. Bishop Tingle, Illinois College, Jacksonville, Ill., 100*l*.

Engineering.—For experiments on ship resistance and propulsion, Prof. W. F. Durand, Cornell University, Ithaca, N.Y., 824*l*.; for study of aluminium bronzes, Mr. Leonard Waldo, New York City, 900*l*.

Exploration.—For preliminary examination of the trans-Caspian region, Mr. Raphael Pumpelly, Newport, R.I., 1300*l*.

Geophysics.—For investigating the flow of rocks, Prof. Frank D. Adams, McGill University, Montreal, 500*l*.; for investigating the subject of geophysical research, &c., Prof. C. R. Van Hise, University of Wisconsin, Madison, Wis., 500*l*.

Geology.—For study of the fundamental principles of geology, Prof. T. C. Chamberlin, University of Chicago, Chicago, Ill., 1200*l*.; for geological exploration in eastern China, Mr. Bailey Willis, U.S. Geological Survey, Washington, D.C., 2400*l*.

History.—For an examination of the historical archives of Washington, Mr. Worthington C. Ford, Library of Congress, Washington, D.C., 400*l*.

Palaeontology.—For continuation of work on the morphology of Permian reptiles, Prof. E. C. Case, State Normal School, Milwaukee, Wis., 100*l*.; for monographing the fossil Chelonia of North America, Dr. O. P. Hay, American Museum of Natural History, 140*l*.; for continuation of his researches on living and fossil cycads, Dr. G. R. Wieland, Yale University, New Haven, Conn., 300*l*.; for preparing a monograph on the Plesiosaurian group, Prof. S. W. Williston, University of Chicago, Chicago, Ill., 160*l*.

Physics.—For study of certain arc spectra, Prof. Henry Crew, Evanston, Ill., 200*l*.; for aid in ruling diffraction gratings, Prof. A. A. Michelson, University of Chicago, Ill., 300*l*.; for experiments on the magnetic effect of electrical convection, Dr. Harold Pender, Johns Hopkins University, Baltimore, Md., 150*l*.; for research, chiefly on the theory of light, Prof. R. W. Wood, Johns Hopkins University, Baltimore, Md., 200*l*.

Physiology.—For experiments in nutrition, Prof. W. O. Atwater, Wesleyan University, Middletown, Conn., 1000*l.*; for preparing report on the physiology of nutrition, Dr. Arthur Gamgee, Montreux, Switzerland, 1300*l.*

Psychology.—For certain investigations on the anthropology of childhood, Dr. G. Stanley Hall, Clark University, Worcester, Mass., 400*l.*; for researches in experimental phonetics, Prof. E. W. Scripture, Yale University, New Haven, Conn., 320*l.*

Zoology.—For determining the laws of variation and inheritance of certain Lepidoptera, Dr. H. E. Crampton, Columbia University, New York, 50*l.*; for investigation of recent and fossil corals, Dr. J. E. Duerden, Chapel Hill, N.C., 200*l.*; for investigating the blind fishes of Cuba, Dr. C. H. Eigenmann, Indiana University, Bloomington, Ind., 200*l.*; for preparing manuscript and illustrations for a monograph on American mosquitoes, Dr. L. O. Howard, Department of Agriculture, Washington, D.C., 400*l.*; for experiments on the behaviour of lower animals, Dr. H. S. Jennings, University of Michigan, Ann Arbor, Mich., 50*l.*; to making a comparative study of the spermatogenesis of insects and other classes of arthropods, and if possible to determine the specific functions of the different chromosomes, Prof. C. E. McClung, Kansas University, Lawrence, Kans., 100*l.*; for investigations in experimental embryology, &c., in Naples, Dr. E. B. Wilson, Columbia University, New York, 200*l.*; for morphology and classification of deep sea sponges, Prof. H. V. Wilson, University of North Carolina, Chapel Hill, 200*l.*; for maintenance of twenty tables, Marine Biological Laboratory, Woods Hole, Mass., 2000*l.*; for maintenance of two tables, Marine Biological Station, Naples, Italy, 200*l.*

SURVEY OF SCOTTISH LAKES.

READERS of NATURE are aware that in the year 1896 Sir John Murray and the late Mr. Fred. P. Pullar commenced to carry out a bathymetrical survey of the fresh-water lochs of Scotland, but the work was brought to a standstill in February, 1901, owing to the tragic death of the younger collaborator, who heroically lost his life in attempting to save others in an ice accident on Airthrey Loch, near Bridge of Allan. As a memorial to this talented young man, his father, Mr. Laurence Pullar, and Sir John Murray resolved to complete this important piece of work at their joint expense, and in the spring of 1902 the survey was resumed under the personal supervision of Sir John Murray, with the assistance of a staff of young scientific men.[1]

During the season of 1902 one hundred and fifty-five Scottish lakes were completely surveyed, and during the past season two hundred and thirty-one, making a total of three hundred and eighty-six of the Scottish fresh-water lochs completed, including all the larger and more important ones. There still remain, however, a good many small and outlying lochs to be surveyed, but it is anticipated that early next season (1904) the actual work of sounding the Scottish fresh-water lochs so far as practicable will be completed. The preparation of the maps for the engraver has been going on continuously, and the publication of the results of the survey has already been commenced in the *Geographical Journal* and the *Scottish Geographical Magazine.*

In continuation of the work of Sir John Murray and the late Mr. Pullar among the lochs of the Forth and Tay basins, the staff of the Lake Survey commenced operations early in 1902 in the northern portion of the Tay basin, and after surveying the principal lochs in that neighbourhood moved northwards and westwards through Perthshire, Inverness-shire, Argyllshire, Ross-shire, Sutherlandshire, and Caithness-shire, sounding all the more important lochs, like Lochs Tay, Rannoch, Treig, Laggan, Arkaig, Shiel, Morar, Maree, Fannich, Shin, Assynt, More, Naver, Loyal, Hope, and many smaller ones. In the spring of 1903 a start was made with the lochs of the Caledonian Canal (Ness and Lochy) and of the surrounding district, then the staff moved southwards to Loch Awe and Loch Lomond, which were sounded for the sake of comparison with the surveys carried out by the Admiralty in the year 1861. Subsequently the staff was split up into small parties, one party proceeding to the south of Scotland to survey Lochs Doon, Ken, Dee, &c., a second party proceeding to Lewis to survey Loch Langavat and other smaller lochs, while a third party proceeded to Orkney and Shetland to survey Lochs Harray and Stenness, and the numerous small lochs in those islands.

In addition to the routine sounding work, continuous observations of a varied description have been carried out on Loch Ness throughout the past season. In order to study the seiches in Loch Ness, a limnograph, constructed in Geneva under the supervision of Dr. Ed. Sarasin, was set up in the grounds of St. Benedict's Monastery at Fort Augustus (by kind permission of the Lord Abbot), and has been in charge of Mr. E. M. Wedderburn. The records obtained are now being studied and classified, and are likely to lead to interesting results; uninodal, binodal, and multinodal seiches have been recognised, and their duration, periodicity, and amplitude determined.

Continuous observations of the temperature of the water at different depths in Loch Ness have also been carried on by Sir John Murray, Mr. Watson, and other members of the staff since July. The temperature changes have been studied systematically—first, by means of platinum resistance thermometers with Callendar's recording apparatus, installed by the Cambridge Scientific Instrument Co., at a cost of several hundred pounds, from a yacht anchored in 300 feet of water off Fort Augustus, and connected with the shore by an electric cable; seconu, by means of ordinary reversing thermometers at Fort Augustus and from a steam yacht, which during several weeks made numerous cruises throughout the length of the loch. Difficulties have cropped up with reference to the working of the electrical thermometers, but the observations made thus far have shown that the waters in Loch Ness are in constant motion, even down as far as 300 to 400 feet. The motion of the upper waters in Scottish lochs has been already studied by Sir John Murray, who advanced the theory that a wind blows the surface water before it, and so causes a slope of the upper isothermals down towards the lee shore. The investigations in Loch Ness confirm this theory, whilst adding some restrictions for this particular case. But the chief interest attaches to the study of the motion of the deeper isotherms, which have never before been studied with care. These isotherms have been found to be swinging in a periodic fashion, with a natural period of about three days. It is supposed that we have here an internal seiche, with the separating surface determined by the greatest change of temperature with depth, the restoring force being given by the difference of density between the warmer upper and the colder deeper waters. The investigations indicate that this internal seiche is started by gales or winds of a strength above the average.

Many biological observations have also been made in Loch Ness and neighbouring lochs by Mr. James Murray, Mr. Scourfield and others, by means of various kinds of townets and drag-nets, with the view of obtaining some insight into the relation between the habits and distribution of the different planktonic and benthonic organisms and the varying physical conditions.

All these limnological investigations have been carried out under the immediate superintendence of Sir John Murray, who took up residence at Fort Augustus from the beginning of July until the end of October, and arrangements have been made for the continuance of the temperature and seiche observations under the charge of Mr. Watson, and of the biological observations under the charge of Mr. James Murray, throughout the winter.

[1] The field staff consisted of Mr. T. N. Johnston, first assistant and zoologist; Mr. James Parsons, chemist; Mr. T. R. H Garrett, geologist; Mr. John Hewitt, zoologist; Mr. James Murray, assistant zoologist: and the following gentlemen took part in the field work for longer or shorter periods during the summer of 1902, viz. Mr. R. M. Clark, Dr. J. Sutherland Black, Sir John Jackson, Mr. D C McIntosh, Mr. James Walker, and Mr. D. J. Scourfield. After the completion of the first season's work, Mr. Parsons and Mr. Garrett received appointments in Ceylon and Borneo respectively, and their places on the staff were taken by Mr. R. B. Young and Mr. R. C. Marshall; in addition, Mr. E. R. Watson and Mr. E. M. Wedderburn joined the staff early in 1903, and in July, when Mr. Young left to take up an appointment in the South African College, Mr. J. H. M. Wedderburn took his place on the staff. The office work in Edinburgh is in charge of Mr. James Chumley, secretary and subeditor, with the assistance of Mr. Robert Dykes.

THE SENESCENCE OF ORGANS AND ITS INFLUENCE ON PATHOLOGICAL PHENOMENA.

A PAPER by Prof. R. Wiedersheim on the senescence of organs in the phylogenetic history of man and its influence on morbid phenomena has been published in the *Politisch-anthropologischen Revue*, II. Jahrgang, Heft 6 (Thuringische Verlags-Anstalt Eisenach und Leipzig).

In emphasising the fact that in many cases organs, or tissues, which are spoken of as vestigial, and are considered to be functionless, may in reality play an important part in the physiological balance of the organism, the author points out that the same is true not only of those parts which are degenerating, but also of those which, though at present of comparatively little importance in the ordinary sense, are in a state of progressive development, or have undergone a change of function.

Pathologists have long recognised the fact that tissues which have been arrested in development during ontogeny are likely at certain times to give rise to pathological conditions, and Prof. Wiedersheim maintains that one is justified in speaking of the old age and senile degeneration of organs, or tissues, in a phylogenetic sense, just as one uses these terms in the case of individuals. He believes that in many cases there is evidence that certain phylogenetic stages in the development of organs, or tissues, are less resistant than others to pathological changes, just as in the individual the tissues are less able, at certain ages, to resist baneful influences arising within or outside the body. A large number of examples are given to show that organs phylogenetically very old are often prone to various diseases, such as carcinoma, &c.

The question is discussed as to why organs which have reached this form of old age are retained, and the conclusion is arrived at that they have no selection-value, and therefore do not affect the preservation of the species.

Organs, or parts of organs, which are in this sense phylogenetically aged are compared by the author to the aged members of a community, who may roughly be divided into two classes—one containing those who conform to the arrangements made for them by the community and take little or no interest in what is going on, the other containing those aggressive individuals who oppose improvements and progress. Society experiences trouble from the members of this latter class, and similarly those phylogenetically aged structures which we have inherited from our ancestors may, if they retain sufficient vitality, seriously affect the vital equilibrium of our bodies.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

PROF. PAGEL has resigned his chair of naval architecture in the Berlin Technical School, on his appointment to the post of technical director of the German Lloyd.

DR. H. GRASSMAN has been appointed professor of mathematics at Halle, Mr. F. C. M. Störmer professor of pure mathematics in the University of Christiania, and Dr. H. Veillon professor of physics and chemistry at Basle.

A COURSE of ten lectures on enzymes and their actions will be delivered by Dr. W. M. Bayliss, F.R.S., at University College, London, on Wednesdays at 5 p.m., beginning Wednesday, January 13. The lectures are open to all internal students of the university without fee, as well as to qualified medical men, on presentation of their cards.

A MEETING of medical graduates of Oxford engaged in teaching in London was held on Tuesday to consider the vacancy in the regius professorship at Oxford caused by the resignation of Sir John Burdon Sanderson. The chair was taken by Sir William Church, president of the Royal College of Physicians. It has been suggested that the present reader in pathology should be appointed regius professor of medicine, so that the emoluments of the chair of medicine might be made to supplement the income of the reader in pathology. A statement setting forth reasons against this proposal has been sent to all medical graduates of Oxford for signature, and the following resolutions were passed at Tuesday's meeting:—"That in the opinion of this meeting the regius professor of medicine should be a physician who is representative of medicine in its widest sense." "That it would be detrimental to the best interests of medicine in Oxford if the regius professorship were converted into a professorship of any one branch of medical study."

SCIENCE does not occupy a prominent place in the new educational monthly entitled *School*, the first number of which has just been received from Mr. John Murray, but the contents include much matter which should stimulate interest in education as a whole. In summing up his impressions of American education, obtained during the recent visit of the Mosely Commission, the Rev. T. L. Papillon remarks, "what has struck me most in the little that I have been able to see of American education is first of all the attitude of the whole people towards public education, and their recognition of it as a prime necessity of national life, for which hardly any expenditure can be too great; next its eminent practical and popular character." Lord Avebury contributes some early recollections, including his Eton days, when the whole course of instruction consisted of Latin and Greek, with one lesson a week in geography. "Neither arithmetic, modern languages, science nor drawing were regarded as essential portions of education, and they did not enter into the school course." There are also articles, among others, on the late Mr. Herbert Spencer and on the education of the engineer.

A SUBJECT which deserves careful and sympathetic investigation by the Board of Education was brought before public notice in the *Morning Post* of December 29, 1903, and dealt with in a leading article. As will be within the knowledge of most readers of NATURE, there are at the Royal Colleges of Science of London and Dublin two classes of students, those, namely, who pay fees, and those who hold scholarships, studentships, or exhibitions, and have been selected by the Board of Education by competition or otherwise. Many of these "Government" students hold what are called national science scholarships. Until 1901 these national scholars received during the forty weeks in the academic year an allowance of thirty shillings a week, out of which the great majority of them had to find board, lodging, clothes, books and apparatus—for the national scholars, of whom there are sixty, come almost exclusively from the lower middle classes, and are without any private means. Since 1901, this weekly allowance has been reduced to twenty-five shillings a week. This reduction in value of the national scholarships has, very naturally, given rise to much dissatisfaction, and early last year a petition, drawn up by the Students' Union, was signed by all the national scholars in the Royal College of Science, London, and on the advice of the council of the college was forwarded to the Board of Education. A reply to this petition, signed by Mr. F. G. Ogilvie, was received in due course, and it contains the statement that "in fixing the present rates the Board were of opinion that an allowance of *1l. 5s.* per week would be a sufficient supplement to the resources of the students to whom scholarships were awarded to enable them to devote their whole time and energy to the prosecution of their studies during the period over which the courses at the Royal College of Science would extend." The suggestion that national scholars have private resources upon which they can draw is certainly based upon a misapprehension; for only very rarely do such scholars receive any allowance from home or friends, and we believe that all the national scholars at present at the Royal College of Science are without private means. There can be no doubt that for a student to live within a reasonable distance of the college at South Kensington, and with comforts sufficient to enable him to perform his work properly, he must spend more than twenty-five shillings a week. The attempt to work earnestly and for long hours every day, and at the same time to pay his way on the amount of his present allowance, must lead to needless irritation, and in many cases to real hardship and permanent injury to health. The only satisfactory solution of the difficulty which has arisen would seem to be the establishment of suitable halls of residence for all scholarship holders, in which that corporate life which is so important a part of university life may be enjoyed by these young men who are studying science for their own and their country's benefit.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, November 19, 1903.—"On the Nematocysts of Æolids." By G. H. **Grosvenor,** New College, Oxford. Communicated by Prof. W. F. R. Weldon, F.R.S.

The nematocysts of æolids were discovered by Alder and Hancock in 1843. As early as 1858 Strethill Wright communicated to the Royal Phys. Soc. of Edinburgh the results of some observations which seemed to prove that these nematocysts were not developed in the body of the æolid, but derived from its cœlenterate prey. This paper, though republished in the *Microscopical Journal* four years later, seems to have been entirely overlooked, and the nematocysts of nudibranchs have been generally supposed to be developed *in situ*, and have often been quoted as an inexplicable example of homoplasy or even as evidence of a close relationship between Mollusca and cœlenterates. C. O. Glaser has, however, recently supported the opposite view.

The evidence brought forward in the present paper in support of Strethill Wright's view is as follows:—

(1) Not only are the nematocysts of æolids and Cœlenterata identical in plan and in mode of discharge, but each of several distinct types occurs in both groups.

(2) The nematocysts of æolids vary from individual to individual within the species, and even in the same individual there may be nematocysts characteristic of two or more distinct genera or families of cœlenterates.

(3) Whenever it is known on what cœlenterate an æolid has recently fed, the nematocysts of the two are found to be identical. Also the nematocysts in the fæces are always indistinguishable from one of the kinds, at least, in the cnidosac.

(4) Those æolids (Janidæ, Fiona, and *Calma glaucoides*) which are known to feed on non-cœlenterate prey have no nematocysts.

(5) Nematocysts and other indigestible bodies have been observed to pass through the ciliated canal from the cavity of the gastric gland into the cnidosac.

(6) Strethill Wright's most conclusive evidence was derived from an experiment of feeding an æolid on a hydroid with nematocysts different from those in the cnidosacs of the æolid. This experiment has been repeated several times, always with the result that the new nematocysts very soon appeared in the cnidosacs of the æolid. In one case three specimens of *Rizzolia peregrina*, with only small pip-shaped nematocysts (6·5 μ) in their cnidosacs, were fed on *Pennaria Cavolinii*, a hydroid with very distinct ovoid nematocysts of two sizes (25 μ and 7 μ). After about a month of this diet the pip-shaped nematocysts were almost entirely replaced by those of Pennaria. These latter were enclosed in cnidocysts in the ordinary way.

Though the nematocysts of æolids are derived from their food, they discharge the threads on extrusion from the cerata into sea-water, and there can be little doubt that they are used as weapons of defence. But an important, and probably the original function of the terminal openings of the cerata is the elimination of the indigestible nematocysts, which, on account of the diffuse character of the digestive system, cannot easily be got rid of through the anus only.

The fact of their discharge when extruded naked into the sea-water from the cnidosacs of an æolid proves that nematocysts work without the intervention of living protoplasm. A study of the conditions of discharge of nematocysts in cœlenterates and æolids, and of their behaviour in various solutions, leads to the conclusion that we have to do with a phenomenon of osmosis.

In the development of the cnidocysts two kinds of cells take part; one, the so-called "cnidoblast," ingests and arranges the nematocysts, while others lying between adjacent cnidocysts take part in the secretion of the membranous walls. Both kinds degenerate in the fully formed cnidocyst.

December 13, 1903.—"Preliminary Note on the Resistance to Heat of *B. anthracis.*" By A. **Mallock,** F.R.S., and Lieut.-Colonel A. M. **Davies.**

This paper describes a series of experiments made by heating water infected with anthrax to various temperatures for various times, in order to determine the temperature and time necessary for the destruction of the spores.

The infected water was sealed in glass tubes and heated in steam in an apparatus which was designed so that any desired temperature could be maintained and simultaneously recorded.

The highest temperature employed was 120° C. and the lowest 99°.

The longest time for which the temperature was maintained was twenty minutes, and the shortest twenty seconds.

From statements made by good authorities as to the great heat resisting power of the spores of anthrax, it was expected that the temperature required to destroy the spores, when expressed as a function of the time for which the temperature had to be maintained, would form a curve, the temperature decreasing as the time of its application increased.

The authors, however, found that out of 95 experiments in which the tubes were heated to 100° C. or more, in 81 all life was destroyed, and out of the remaining 14 experiments, in which some growth took place after cultivation in broth, 12 had become contaminated. After heating 18 experiments were made at temperatures between 99° C. and 100° C. In 5 of these experiments some growth occurred after cultivation, 4 of these being found contaminated.

The conclusion arrived at is that when anthrax spores are heated in water to 100° C. or more, even for twenty or thirty seconds, their destruction is almost certain.

Chemical Society, December 16, 1903.—Prof. W. A. Tilden, F.R.S., president, in the chair.—The following papers were read:—The relative strengths of the alkaline hydroxides and of ammonia as measured by their action on cotarnine, by Messrs. **Dobbie, Lauder** and **Tinkler.** When aqueous solutions of cotarnine are treated with alkaline hydroxides or ammonia the alkaloid is changed from the "ammonium hydroxide" form to the "carbinol" form. As solutions of these two forms of cotarnine exhibit very different absorption spectra, it is possible by this means to observe the rates at which this change is brought about by different alkalis. The relative strengths of the alkaline hydroxides as determined by this method are practically identical with those obtained by other physical methods.—Peroxylaminesulphonates and hydroxylaminetrisulphonates, by Mr. T. **Haga.**—An investigation of the sulphazilates and metasulphazilates first obtained by Fremy. Peroxylaminesulphonic acid, by Dr. E. **Divers.** The author shows that the bluish-violet substance produced by the action of sulphur dioxide on sulphuric acid containing nitrososulphuric acid is probably, as has already been asserted by Sabatier, peroxylaminesulphonic acid, the potassium salt of which is described in the preceding paper.—Constitution of nitric peroxide, by Dr. E. **Divers.** It is shown from the results of Haga's investigations that the *mono*-nitric peroxide must have the formula $O:N_2O$, whilst the dinitric peroxide must have the constitution $(NO)_2O_2$.—Halogen derivatives of diphenyl and dihydroxydiphenyl, by Mr. J. C. **Cain.**—Notes on some natural colouring matters, by Messrs. A. G. **Perkin** and E. **Phipps.** The flowers of *Prunus spinosa* contain the two colouring matters quercetin and kampherol. The Japanese dye-stuff "Fukugi" contains a yellow substance closely related to luteolin. A number of derivatives of morin, hesperitin, myricetin and curcumin are also described.—The estimation of methyl alcohol in the presence of ethyl alcohol, by Messrs. T. E. **Thorpe** and J. **Holmes.** The method is based upon the difference in behaviour of these two alcohols towards a mixture of potassium dichromate and sulphuric acid.—Separation and estimation of silver cyanide and silver chloride, by Mr. R. H. A. **Plimmer.** The mixture is treated with boiling dilute nitric acid, and the hydrocyanic acid so liberated distilled off and estimated as silver cyanide.—Estimation of hydroxyl radicles, by Messrs. H. **Hibbert** and J. J. **Sudborough.** A modification of Tschugaeff's method is described.—Diortho-substituted benzoic acids, part v., formation of salts from diortho-substituted benzoic acids and organic bases, by Messrs. J. J. **Sudborough** and W. **Roberts.**—Cis-π-camphanates of *d*- and *l*-hydrindamines, by Prof. F. S. **Kipping.**—Resolution of *dl*-methylhydrindamine, by Mr. G. **Tattersall.**—Isomeric salts of *d*- and

l-methylhydrindamines with *d*-chlorocamphorsulphonic acid, by Mr. G. **Tattersall.**—The four optically isomeric *l*-menthylamines and their salts, by Messrs. F. **Tutin** and F. S. **Kipping.**—Preparation of the tetra-alkyl derivatives of stannimethane, by Messrs. W. J. **Pope** and S. J. **Peachey.** The authors have prepared a number of these derivatives by the interaction of magnesium alkyl haloids with stannic chloride or alkyl derivatives of the latter.—Optically active esters of β-ketonic and β-aldehydic acids, part iv., condensation of aldehydes with menthyl acetoacetate, by Messrs. A. C. O. **Hann** and A. **Lapworth.**—Estimation of the adulterant in citronella oil, by Mr. M. K. **Bamber.**

Geological Society, December 16, 1903.—Sir Archibald Geikie, Sec.R.S., vice-president, in the chair.—The igneous rocks associated with the Carboniferous Limestone of the Bristol district, by Prof. C. Lloyd **Morgan,** F.R.S., and Prof. Sidney H. **Reynolds.** Evidence for the contemporaneous origin of the igneous rocks is given for several localities. At Middle Hope the ejectamenta thin to the east, and lava is only found to the west; at Spring Cove, near Weston-super-Mare, small lapilli were found in the limestone 8 feet above the basalt. At Goblin Combe there is the most characteristic section of ashy beds; the lenticular bands of greenish tuff, the limestone-intercalations, the admixture of lapilli, limestone fragments, and oolitic grains are stamped with the mark of submarine volcanic action; lava closely underlies these breccias and tuffs. There is evidence of only one volcanic episode, which occurred in all cases after the Zaphrentis beds had been laid down, and before the strata characterised by Chonetes and Streptorhynchus were deposited. The lavas are olivine-dolerites or basalts, with phenocrysts of olivine or augite. They are frequently amygdaloidal, and in the variolites highly-altered felspar-phenocrysts occur. The rocks vary in grain. The tuffs are all calcareous, and most are best described as "ashy limestones." The bulk of the lapilli varies from one-hundredth part of the rock to about one-third, and their composition is related to that of the basaltic lavas of the district.—The Rhætic beds of England, by Mr. A. Rendle **Short.** The paper opens with a description of four new exposures of these rocks; one at Redland rests upon Carboniferous Limestone; a second is at Stoke Gifford, with a continuous, well-developed landscape-marble, the insect bed, and no bone bed; a third at Cotham Road (Bristol) yields baryta, celestine, and Naiadita at horizons containing no other fossils; and the fourth, at Aust, has given measurements of the uppermost 13 feet. An account is given of the constituent beds, with reference to the conditions of deposition.

PARIS.

Academy of Sciences, December 28, 1903.—M. Albert Gaudry in the chair.—M. Troost was elected a vice-president for the year 1904.—Researches on the density of chlorine, by MM. H. **Moissan** and Binet **du Jassoneix** (see p. 233).—On some new syntheses effected by means of molecules containing the methylene group associated with one or two negative radicals. The action of epichlorhydrin upon the sodium derivative of acetylacetone, by MM. A. **Haller** and G. **Blanc.** The reaction between epichlorhydrin and sodium acetylacetone is distinguished from the reactions between epichlorhydrin and the sodium derivatives of acetoacetic ester, benzoylacetic ester, and similar compounds by the fact that the chlorine reacts with the sodium, giving rise to products free from chlorine, one of which appears to be $CH_3.C{=}CH—CH_2—CH.CH_2OH$. This changes spontaneously into a ketone, the constitution of which is under examination.—The potash soluble in the water of the soil and its utilisation by plants, by M. Th. **Schlœsing,** jun.—On the first volume of the photographic catalogue of the sky published by M. A. Donner, director of the Observatory of Helsingfors, by M. **Lœwy.**—Remarks by M. R. **Zeiller** on the work of M. Michel Lévy on the fossil flora of the Tonkin Coal-measures.—Remarks by M. Alfred **Picard** on presenting his report on the Exhibition of 1900.—On the scapular and pelvic hands in the chondropterygian fishes, by M. Armand **Sabatier.**—On the limit of the Jurassic and Cretacean in the eastern part of the Pyrenees, and on the existence of two distinct epochs of formation of couzeranite limestones, by MM. Ch. **Depéret** and O. **Mengel.**—On the influence of the depth of immersion of a vessel on the speed, by M. J. A. **Normand.** A mathematical investigation into the relations existing between the weights of coal, engines, and other load, the maximum speed, displacement, and the exponent according to which the velocity varies in the neighbourhood of the maximum power. On a property of functions, by M. H. **Lebesgue.**—On linear partial differential equations, by M. J. **Le Roux.**—The convergence of periodic superposed roots, by M. Paul **Wiernsberger.**—On a new system of road traction called *à propulsion continue*, by M. Charles **Renard.** A description of a method of mechanically transmitting the power of a locomotive to a series of attached vehicles, the whole train forming a kind of articulated locomotive. The advantages gained are great precision in steering round corners, and a reduction in the weight of the locomotive, since the tractive power is not limited, as in the usual type, by the adhesion of its wheels.—New electromechanical arrangements of engagement and gradual change of velocity, by M. Paul **Gasnier.** A method of using an electrically driven motor by which its speed can be gradually varied from nothing to maximum as required.—On the extension of the Clapeyron formula to all indifferent states, by M. L. **Ariès.**—On the luminous intensity of stars and their comparison with the sun, by M. Charles **Fabry.** Measurements made on the intensity of the star Vega, near the zenith, in calm weather and at the sea-level, gave a value equal to a candle at 780 metres distance, or 1.7×10^{-6} candles. A relation between magnitude of a star as usually measured by astronomers and the candle-power is then worked out.—On the difference of temperature of bodies in contact, by M. E. **Rogovsky.**—On sliding discharges, by M. J. **de Kowalski.**—On a diffusiometer, by M. J. **Thovert.** A modification of an instrument previously described, suitable for volatile liquids. The rate of diffusion is measured by the change in the refractive index of the liquid.—On a new method of preparing some anhydrous crystallised fluorides, by M. **Defacqz.** By heating a mixture of calcium chloride and manganese fluoride, the former being in excess, to 1000°–1200°, crystallised calcium fluoride is obtained, either in cubes or octahedra.—Electrical osmosis in liquid ammonia, by M. Marcel **Ascoli.**—On the dissociation of alkaline carbonates, by M. P. **Lebeau.** Sodium carbonate, heated in a vacuum, is appreciably dissociated, the pressure of the carbon dioxide varying from 1 mm. at 700° C. to 41 mm. at 1200° C. Similar measurements were also carried out with the carbonates of potassium, rubidium, and cæsium.—On the α-amino-nitriles, by M. Marcel **Delépine.**—The combination of saccharose with some metallic salts, by M. D. **Gauthier.**—On the transformation of the primary α-glycols into the corresponding aldehydes, by M. **Tiffeneau.** A study of the mechanism of the transformation of $(CH_3).(C_6H_5).C(OH)—CH_2OH$ into $(CH_3).(C_6H_5).CH.CH:O$ by the action of 25 per cent. sulphuric acid.—On the nitric esters of the acid alcohols, by M. H. **Duval.** Description of the preparation and properties of the nitrates of acetoxyacetic, lactic, α-oxybutyric, and glycollic acids.—The action of carbon dioxide upon aqueous solutions of aniline in the presence of nitrites, by M. Louis **Meunier.** An aqueous solution of aniline mixed with sodium nitrite gives diazoamidobenzene in presence of carbonic acid. Silver nitrite with aniline gives the silver salt of diazoamidobenzene. There is no reaction between sodium nitrite and aniline in aqueous solution in the absence of carbon dioxide.—On the retrogradation of starch, by M. L. **Maquenne.**—The preparation of hydrogenated alcohols of the aromatic series, by M. Léon **Brunel.** By the action of hydrogen in the presence of reduced nickel at 170°–200° C., phenol gives cyclohexanol, thymol, hexahydrothymol, and carvacrol hexahydrocarvacrol.—On the oxidation of guaiacum by laccase, by M. Gabriel **Bertrand.**—The development of annual plants: study of the mineral bases, by M. G. **André.**—On the culture of sarrasin in the presence of a mixture of algæ and bacteria, by MM. **Bouilhac** and **Giustiniani.**—The evolution undergone by fishes of the genus Atherina in fresh and brackish water, by M. Louis **Roule.**—New facts on the *n*-rays of physiological origin, by M. Augustin **Charpentier.** The emission of the *n*-rays by living bodies is not peculiar to man; it has been found in rabbits, frogs, and other animals. The most important part of the physiological emission of the *n*-rays

appears to take place in the nervous system, especially in the nerve centres.—The determination of the perceptible minimum and the duration of luminous perception in persons of weak sight, by M. S. **Durand.**—On mountain sickness, by M. **Kronecker.**—On the modifications induced in the respiration by the altitude of Mt. Blanc, by M. J. **Vallot.** The relation between the volume of air respired and the time spent at the summit is shown graphically, and also the variation in the weight of air breathed.—On a relation between the work and the so-called statical work equivalent on the ergograph, by M. Charles **Henry** and Mlle. J. **Ioteyko.**—Researches on the *rôle* of the interstitial gland of the testicle. Experimental compensating hypertrophy, by MM. P. **Ancel** and P. **Bouin.** Phototropism in the higher Artiozoa, by M. Georges **Bohn.**—The action of anethol upon the organism, by MM. E. **Varenne,** J. **Roussel** and L. **Godefroy.** Anethol shows no toxic effects, and may be safely used as a therapeutical agent.—The action of radium upon different tissues, by M. J. **Danysz.** The tissues, and especially the epithelial tissues of young animals, are much more sensitive to the action of radium rays than the tissues of adults.—On a consequence of cross-fertilisation, by M. Leclerc **du Sablon.**—On a true hybrid of chasselas by *Ampelopsis hederacea*, by M. **Grille.**—On the *rôle* of calcium oxalate in the nutrition of plants, by M. **Amar.** The lime (in the form of nitrate) necessary to the constitution of the plant is entirely assimilated up to a certain proportion, depending on the species; above this proportion the excess of lime is eliminated in the form of crystals of calcium oxalate.—On a disease of the leaves of the tobacco plant, by M. H. **Bouygues.**—On the Glacial deposits of the Garonne, by M. L. A. **Fabre.**—The geology of the western Alps, by M. Emile **Haug.**—Contribution to the study of the basaltic rocks of East Africa, by M. H. **Arsandaux.**—On the lakes of the Upper Engadine, by M. André **Delebecque.** On the relation which exists between the proportion of gluten contained in different wheats and the proportion of total nitrogenous materials, by M. E. **Fleurent.**

DIARY OF SOCIETIES.

THURSDAY, JANUARY 7.

ROYAL INSTITUTION, at 3.—Extinct Animals: Prof. Ray Lankester, F.R.S.

RÖNTGEN SOCIETY, at 8.30.—The Revelations of Radium: Dr. G. B. Batten.

FRIDAY, JANUARY 8.

ROYAL ASTRONOMICAL SOCIETY, at 5.—Transformation of Hansen's Tables: P. H. Cowell.—Note on the Use of Long Focus Mirrors for Eclipse Work: H. H. Turner.—New Double Stars detected with the 17¼ inch Reflector during the Year 1903: Rev. T. E. Espin.—Ephemeris for Physical Observations of Jupiter 1904–5: A. C. D. Crommelin.—The Rotation Period of Saturn in 1903: W. F. Denning.—The "Great" Magnetic Storms, 1875 to 1903, and their Association with Sun-spots, as Recorded at the Royal Observatory, Greenwich, communicated by the Astronomer Royal: E. W. Maunder.—Suggested Connection between Sun-spot Activity and the Secular Change in Magnetic Declination: Mrs. E. W. Maunder.—On the Chromatic Correction of Object Glasses: A. E. Conrady.—The Aurora and Magnetic Disturbance: William Ellis.—*And, time permitting*, Discussion on Methods of Reproducing Astronomical Photographs.

ROYAL GEOGRAPHICAL SOCIETY, at 4.—Adventures in Antarctic Lands and Seas: Lieut. Ernest Shackleton. (Lecture to Young People.)

SATURDAY, JANUARY 9.

ROYAL INSTITUTION, at 3.—Extinct Animals: Prof. Ray Lankester, F.R.S.

MONDAY, JANUARY 11.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—Exploration on the Southern Abyssinian Border: Captain Philip Maud.

VICTORIA INSTITUTE, at 4.30.—Ancestral Worship: Rev. Arthur Elwin.

TUESDAY, JANUARY 12.

ROYAL INSTITUTION, at 5.—The Development and Transformations of Animals: Prof. L. C. Miall, F.R.S.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Electrical Re-construction of the South London Tramways on the Conduit System: Alexander Millar.

WEDNESDAY, JANUARY 13.

SOCIETY OF ARTS, at 5.—Navigation of the Air: Eric S. Bruce.

THURSDAY, JANUARY 14.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—The City and South London Railway; Working Results of the Three Wire System applied to Traction, &c.: P. V. McMahon. (Adjourned discussion.)—On the Magnetic Dispersion in Induction Motors, and its Influence on the Design of these Machines: Dr. Hans Behn-Eschenburg.

ROYAL INSTITUTION, at 5.—The Flora of the Ocean: G. R. M. Murray F.R.S.

MATHEMATICAL SOCIETY, at 5.30.—On Various Systems of Piling: Prof. J. D. Everett.—The Differential Equation

$$\frac{\partial^2 V}{\partial x_1^2}+\frac{\partial^2 V}{\partial x_2^2}+\ldots+\frac{\partial^2 V}{\partial x_n^2}=0:$$

H. Bateman.—On the Notion of Lines of Curvature in the Theory of Surfaces: Dr. G. Prasad.—On Groups of Order $p^a q^\beta$: Prof. W. Burnside.

SOCIETY OF ARTS, at 4.30.—The Presidency of Bombay: Sir William Lee-Warner, K.C.S.I.

FRIDAY, JANUARY 15.

ROYAL INSTITUTION, at 9.—Shadows: Lord Rayleigh.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.

SATURDAY, JANUARY 16.

ROYAL INSTITUTION, at 3.—British Folk Song: J. A. F. Maitland.

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THURSDAY, JANUARY 14, 1904.

EXPERIMENTAL STUDIES IN DEVELOPMENT.

Einführung in die Experimentelle Entwickelungsgeschichte. By Prof. Otto Maas. Pp. xvi+203. (Wiesbaden: J. F. Bergmann, 1903.) Price 7 marks.

ONE of the most fascinating branches of biological inquiry is that concerned with the investigation of those factors that underlie organisation and determine the course of development of the individual from the egg to its adult condition. From old time the question as to why a hen's egg should give rise to a fowl and not to a lizard or a mammal is one that has invited but never been met with a satisfactory answer, any more than the agencies have been recognised that direct and determine the orderly series of cell divisions culminating in the production of a specific form with all its marvellous organs and complex tissues.

It was formerly believed that, in some mysterious fashion, the actual structure of the adult lay concealed in the egg, much as the flowers of some of our trees can be detected in a resting condition, while it is still winter, by stripping off the bud scales that enfold them. When this view had been shown to be both logically and as a matter of experience untenable, the doctrine of epigenesis displaced it, but this, too, failed to provide a satisfactory basis on which a comprehensive explanation of the phenomena could be built up. Thus in quite recent times a revival of the evolution-theory has arisen, not, indeed, in the older and cruder form, but as promulgated by Weismann and his followers it has appeared to throw light on, and indicate a reason for, the remarkable phases passed through by the cell-nucleus during its division, and at the same time it took cognisance of the extraordinary phenomena that precede and accompany sexual reproduction. It has, however, been subjected to strenuous criticism, and weighed in the balance it, like its predecessors, has been found wanting.

The centre of gravity of current investigation is shifting again from the nucleus to the extra nuclear cell-protoplasm (cytoplasm). As the result of experiment, it has become certain that this part of the cell has to be reckoned with in any theories that pretend to group the facts together, and it is pretty certainly a good deal more than a mere nutritive substance which simply furnishes the nucleus with substances that may enable the latent possibilities of the latter to be converted into actual entities having the specific quality of form and other properties. The old definition of the cell as a mass of protoplasm containing a nucleus is still found to hold good, but the parts played by the two constituents admit of more precise delimitation than was the case even a few years ago.

A step of no small importance was made when it was discovered that by centrifugalising fertilised frogs' eggs, so as to drive the yolk up to one end of the egg, the course of segmentation becomes artificially meroblastic. Thus a condition is produced which is actually met with in many eggs (*e.g.* of molluscs) in which the yolk is present in large quantity and is unequally distributed.

Still more important was the further discovery that the first few blastomeres of a fertilised segmenting egg could be separated and induced to continue their development as isolated individuals. For this afforded an opportunity of deciding whether the organism was the product of its cells, or the cells of the organism. The results strongly point in the latter direction. The same conclusion is reached from the experiments of Hertwig, who by compression succeeded in causing the early cells of the embryo to take up abnormal positions, but the organisation of the larva did not then follow the cell-arrangement, but superseded it. The experiments with isolated blastomeres do not give the same results in all cases. Thus, if they are isolated at the first segmentation of the ovum of an Amphioxus, each gives rise to a small but perfect embryo, and thus behaves as though it were a small egg. In the sea-urchins, the isolated cells at first continue to develop as though the missing part were still present, that is, they give rise to *partial* embryos. But very soon the form of the normal embryo at the corresponding stage is made good, and small but perfect larvæ may result. Yet another example is seen in *Beroë* and some other animals, in which, whilst segmentation at first goes on as though the isolated part were a small egg, at later stages the embryo exhibits various structural defects.

It is very important to notice that these various types of behaviour do not depend on the nuclei. It might be thought that as the small larvæ, at first often defective (sea-urchins), had arisen from cells the nuclei of which had arisen by division from that of the original ovum, the defective character should be correlated directly with this fact. The nuclei might be supposed to have diverged in character, so that, for example, that of one cell contained in itself the latent potentialities of a definite half or other portion of the embryo. But such an explanation is directly contradicted by the facts as shown in Amphioxus, and would not be easily reconciled either with such cases as that of *Beroë* or by the commonly occurring modification of the further processes whereby small, but otherwise perfect, larvæ may arise in spite of the initially different mode of segmentation. Moreover, it has been shown that when freshly fertilised eggs are shaken so as to separate off portions of the cytoplasm *before* segmentation, modifications are produced very similar to those that occur in separated blastomeres. This appears to tell conclusively in favour of the great importance of the cytoplasm as a factor in determining the progress of development. In fact the egg, as has been well said, is itself an organism. Not that the parts characteristic of the adult are there present *in esse*, but the *substance*, the primordial materials out of which the early structures are severally built up, is actually present in the unsegmented egg.

There is some direct evidence available on this point. In many eggs differences of colour or texture can be seen to occupy definite positions in the egg, and if it is rotated these zones often rearrange themselves,

apparently under the influence of gravity, so as to take up the same configuration as before. This fact is highly significant in connection with the production of perfect and normal embryos, although the positions of the earlier formed blastomeres may have been so artificially shifted that their cell descendants occupy abnormal positions in the otherwise normal larva.

The correctness of this general interpretation is also supported by the readiness with which partially separated blastomeres will form double embryos. The two masses of nearly isolated cytoplasm thus develop independently, the lack of adequate contact or continuity between the corresponding parts of the two cells being apparently responsible for the monstrosity. An instructive comparison is afforded by a consideration of the results of artificially induced union of originally separate blastomeres of similar order. If these are approximated so that the axes of the different substances in each are parallel, they segment as one organism, that is, the cell division is coordinated. If, however, the axes are divergent, then each blastomere continues to segment more or less independently, and monsters of various degrees result.

These embryos, arising from isolated blastomeres of the first or following cell-generations, and also those originating from the fusion of previously isolated ones, concur in one remarkable characteristic, viz. the size of the larva at any given stage is proportionate to the relation between the cell from which the embryo actually arose, and the ovum of the species. Thus embryos from either of the first two blastomeres are half the normal size, and so on.

This variation in size is effected by a corresponding reduction in the *number* of cells that go to make up the different parts or regions of the whole, and not by a difference in their *size*. At first sight this circumstance might seem to favour the hypothesis of "unequal" nuclear divisions, *i.e.* the production of daughter cells with constantly segregating potentialities. But any such explanation is at variance both with the facts of development, taken as a whole, and with those of regeneration as well. What the evidence does seem to point to is the existence of definite substances present in the cytoplasm, and that these, though not actually representing the several organs *in parvo*, nevertheless do represent substances necessary to the formation of these organs—a very different thing. It is, then, intelligible why an organism that is left with only half the amount of any one such substance can only produce half the number of cells during cleavage; and a working hypothesis can be formed as to why regeneration is possible in some cases whilst it is apparently excluded in others. There exist strong grounds for believing that the formative stimuli leading to organogenetic development normally reside in the nucleus, but unless the substances capable of responding or of cooperating in the response to a stimulus are present, a normal result need no more be expected than that a printing machine should be capable of turning out a printed page unless the type had been inked.

But though the ground is being broken, much will have to be done before we are in a position to give a satisfactory explanation of the phenomena of development and regeneration. At present it is sufficient to analyse and investigate experimentally the agencies that are concerned in these and other vital processes; we shall thus, and only thus, be able to elevate the surviving elements of existing hypotheses to the rank of well-founded theory.

The volume by Dr. Maas will form a useful source of information for those who may desire to know what is being done in these directions. Its author does not claim to have treated the subject exhaustively, and, indeed, we could wish the sections dealing with the chemical and physical aspects of the matter had been expanded. Nor will the reader who is familiar with the work of Driesch, Roux and others perhaps find much recorded that will be new to him, but the presentation of the subject-matter is, on the whole, judicious and critical. The work covers a wider range than might be gathered from the general tenor of the present article, but as the whole subject deserves more general attention than it receives, it appeared to be more useful to attempt to indicate some of the actual results and the questions arising from them, than merely to give a discursive synopsis of a book that should be read by all who are interested in the more important biological problems of the present day.

J. B. F.

THE ALKALI AND CHLORINE INDUSTRY.

La Grande Industrie Chimique Minerale. By E. Sorel, Ancien Ingénieur des Manufactures de l'État. Pp. 679. (Paris: C. Naud, 1904.) Price 15 francs.

THIS work is concerned with the alkali industry and with those manufactures which naturally group themselves around it. That is to say, it treats of soda and potash, the chief salts of sodium and potassium, the halogens, and the principal industrial compounds of the latter, such as bleaching-powder and the chlorates.

The point of view adopted is essentially that of the manufacturing chemist or chemical engineer. Generally, however, the treatment is rather broader than this might indicate. Thus the history of a process or the growth of an industry is often outlined, and the mode of occurrence of the raw materials used is described more or less fully. As further illustrating the same point we note that, in connection with hydrochloric acid, several pages are devoted to a discussion of the effects which the acid vapours discharged from chemical works produce upon the vegetation of the locality. This, again, is followed by a chapter in which the general principles of the condensation of vapours are discussed from the thermodynamical standpoint. Nor does the author disdain to lighten his pages with occasional items of miscellaneous—not to say trivial—information. We learn, for instance, that in Central Africa "les enfants courent après un morceau de sel, comme les nôtres après un bon-bon."

The salt industry is dealt with in the opening chapter. There is a good description of the production of salt from sea-water, and some particulars of the salt deposits of Cordova, Lorraine, Stassfürt, and Transyl-

vania are included. The treatment of the mother-liquors for the recovery of potassium salts leads then to the next chapter, in which the production of potassium chloride and sulphate is described.

Here in this second chapter we have an instance, graphically told, of the kaleidoscopic changes which an unexpected discovery may sometimes bring upon a seemingly permanent industry. Balard, the discoverer of bromine, had devoted some years of his life to the creation of a new manufacture—the recovery of potassium salts from sea-water, to wit—for the benefit of his beloved Provence. The methods were worked out satisfactorily, an influential company was formed, and everything promised a great commercial success. In fact, the products were already on the market when news came of the discovery, in the "dead lands" round the little Prussian town of Stassfürt, of those great deposits of potassium and magnesium salts which have since made the district famous. Down went the price of potassium chloride to less than one-half its former figure, and with the fall vanished the new French industry. It did not, indeed, succumb without a brave little struggle, and during this the processes were so much improved that, as the author apparently thinks, a fortunate chance might even now bring them to the front again. But at that time, at any rate, the fight was hopeless, and the works round Stassfürt were speedily left victors in the markets which they have ever since controlled.

Potassium carbonate from vegetable sources is next treated of. The burning of plants for the sake of their "potashes" the author regards as a barbarous and brutal kind of industry. It appears that the march of civilisation in the United States is shown by the gradual shifting of the centres where potassium carbonate is prepared—a remark which recalls, though antithetically, the epigram about a nation's progress being measured by the sulphuric acid it requires. It is interesting to note that although at one time potash was largely displaced by soda in manufacturing processes, yet now, thanks to agricultural requirements, the demand for potassium salts is greater than ever.

Iodine and bromine form the subject of chapter iv., and are clearly if somewhat shortly described. The next twelve chapters are occupied chiefly with the soda industry. The ammonia-soda process is lucidly dealt with in two short chapters, and a considerable amount of space is devoted to the Leblanc process. The author justifies this on the ground that the latter method has still some vitality left, and is always capable of making progress. Much of the description is certainly interesting, especially that giving personal details of the discoverer, his successes, and his vicissitudes. But the interest is mainly historical. Even in this country the battle of the ammonia *versus* the Leblanc process can hardly be said to be so doubtful in its issue as the author seems to think it. The electrolytic method is barely mentioned; a little more space might well have been devoted to it.

In any adequate account of the alkali industry this country must figure largely, and such names as those of Gossage, Hargreaves, Mactear, Muspratt, and Mond receive due mention in the present work. The English Alkali Acts, too, although regarded as "Draconian," are nevertheless commended. Indeed, the author is inclined to attribute much of the progress which the alkali manufacture has made in Great Britain to the fact that the makers were forced to collect their hydrochloric acid instead of distributing it broadcast over the countryside. It is, of course, an old story, but it will bear recalling, how, in spite of the great clamour raised, the alkali manufacturers were compelled to take those steps which eventually proved to be their economic salvation. The rejected stone became the headstone of the corner; the troublesome by-product presently supported the whole industry.

Chlorine, bleaching-powder, and chlorates are dealt with in the last five chapters. There is nothing particularly new, but the descriptions include the standard processes, such as those of Deacon, Weldon, Dunlop, Mond, and Péchiney, and give a good general idea of this branch of chemical industry.

The work contains a number of illustrations, but lacks an index. It will be useful to those who require something more complete than a general text-book description, but less extensive than Lunge's standard treatise.

C. Simmonds.

THE ELEMENTS OF ELECTRICAL ENGINEERING.

Electricity and Magnetism. By C. E. Ashford, M.A. (London: Edward Arnold, n.d.) Price 3*s.* 6*d.*

Electric and Magnetic Circuits. By Ellis H. Crapper, M.I.E.E. (London: Edward Arnold, n.d.) Price 10*s.* 6*d.*

A Text-book of Electrical Machinery. Vol. i. Electric, Magnetic and Electrostatic Circuits. By H. J. Ryan, H. H. Norris, and G. L. Hoxie. (New York: John Wiley and Sons; London: Chapman and Hall, Ltd., 1903.) Price 2.50 dollars.

THE best method of training electrical engineers will probably remain a subject of discussion so long as the profession continues to be a profitable one. Whether recourse should be had to the factory or to the technical college; whether a combination of these two is desirable or necessary, and if so, in what manner they should be combined; and whether the course at the technical college should be entirely by lecture and experiment, or should make free use of that royal road to excellence, the text-book; these and kindred questions will always be discussed and will never be settled. Whilst the discussion goes on the writers of text-books continue to flourish until the difficulty of deciding whether to have recourse to text-books or not is overshadowed by the greater difficulty of deciding which would be the most profitable to read. The three books before us illustrate how the budding electrical engineer may be caught when he is yet fresh in knickerbockers and led by easy steps to a complete mastery of his profession. Mr. Ashford's "Electricity and Magnetism" is a school-book; it starts by assuming that the pupil has no knowledge of the subject at all, and, leading him by a path of experimental inquiry, ends by leaving him well fitted to begin on Mr. Crapper's more advanced treatise. This read,

and the fundamental principles of continuous current circuits mastered, it only remains to study alternating currents in the work of Messrs. Ryan, Norris and Hoxie.

It is difficult to find anything particular to say of either of the three books, since each treats its subject in the manner which has become by now fairly familiar. They all possess certain merits not to be found in other books of a like kind, and certain defects which it is easy enough for the critic, who has only to read and not to write the book, to make much of. For example, Mr. Ashford proves Ohm's law with electromagnetic instruments, a logical mistake which it seems hopeless to eradicate from the text-book; Mr. Crapper does not prove it at all, but states that "on account of its importance as the fundamental law of electrical measurements, it may be considered in the strictest sense a law of nature," which seems to us rather a novel criterion for laws of nature. Mr. Crapper is also somewhat loose in his use of the terms force, energy, and power ("watts of energy," for example, is an expression rather difficult to understand), and, indeed, in his definitions generally —an electrolyte is defined in one place as "a compound liquid with a metallic salt in solution." These are, perhaps, slight defects, but one is justified in requiring more exactness of expression and more careful attention to detail in a text-book than one would think necessary in a lecture. The best justification that a text-book can claim is that it gives precision to the knowledge obtained experimentally in the laboratory.

Mr. Ashford's book is intended as a laboratory handbook; in our own opinion the last thing wanted in a laboratory is a handbook. Such things are never to be found for the practical experiments the electrical engineer has to make when his days of school and college are over, and the greatest benefit of the laboratory training is that it should train the student to walk alone. When experiments are so carefully described, and the results to be got and the conclusions to be drawn from them so plainly pointed out as in this book, the value of the experiment is greatly discounted, if the student even takes the trouble to carry it out properly. Mr. Crapper, on the other hand, errs by giving too much importance to the exercise class; if any student works through the enormous number of examples given in the book he will have done a great deal of arithmetic, but we doubt whether his engineering faculties will have benefited much.

Messrs. Ryan, Norris and Hoxie proceed on what is, at any rate to English readers, the somewhat novel plan of plunging forthwith into the phenomena of alternating currents, "from which the treatment of continuous current phenomena follows naturally." This seems to us rather putting the cart before the horse, as we should certainly think the understanding of alternating currents must follow, and even then with difficulty, that of continuous current phenomena. This method involves also considerable mathematical knowledge in the student, and from this point of view alone seems scarcely the most suitable to adopt.

In conclusion, we may repeat that fault-finding is easy, and that these three books have much to recommend them. They are thoroughly up-to-date, and will compare very favourably with any three other books covering the same ground which we can call to mind. Their fault is not that they are bad text-books, but that they are good text-books.

MAURICE SOLOMON.

THE PHYSIOLOGY OF MENTAL ACTIVITY.

Etudes de Psychologie physiologique et pathologique. By E. Gley. Pp. viii + 335. (Paris: Félix Alcan, 1903.) Price 5 francs.

TWO-THIRDS of Prof. Gley's book are devoted to a historical and critical review of our knowledge of the physiological changes that accompany intellectual activity. The writer gives a lucid account of his own contributions to the subject in chapters upon the relation of mental work to the cardiac, respiratory, vascular, excretory, and thermogenic mechanisms. He concludes that mental work is accompanied by increased rate of heart-beat (at least in the early stages of activity), by arterial constriction and increased peripheral resistance in the extra-cerebral circulation, and by active dilatation of the arterioles of the brain. No mention is made of the experiments and views of British physiologists in regard to the much-debated presence of a vaso-motor mechanism in the brain. The author bases his affirmative conclusion merely on a study of the changes in form of the carotid pulse-curve during intellectual rest and activity. He is also inclined to believe that during intellectual activity the temperature of the brain rises slightly. Yet the evidence in favour of this view seems very far from adequate, for it has never been shown that the amount of carbonic acid evolved is increased during the activity of nervous tissue, and we are powerless to decide whether the slight rise of cerebral temperature may not be due to other causes, *e.g.* to the increased blood supply to the brain, to diminution in loss of heat from the skin arising from the already mentioned peripheral vascular constriction. To cerebral metabolism the author also attributes the increase of calcium salts in the urine during intellectual activity. This increase is said to be accompanied by more abundant excretion of urine and of magnesium salts and phosphoric acid.

Throughout the book Prof. Gley does not attempt to veil his intention to find analogies between cerebral and glandular activity, but *a priori* views, however excellent, are of little real avail in the solution of such an unusually difficult problem. There is, indeed, one complicating factor which is invariably neglected by physiologists, to which attention may be directed here. It is now generally believed that no mental process is possible without the simultaneous production of efferent impulses—in other words, thoughts must express themselves in muscular activity. Even if this maxim exaggerates the truth, there can be no doubt that, as a rule, active intellectual efforts pass over into, and to some extent manifest themselves as, muscular contractions. These contractions may appear as vaso-motor changes or as involuntary movements, and they are largely responsible, at least when

well pronounced, for changes in the general feeling or emotional tone of the individual. Now, in the first place, it is impossible to rule out changes in emotional tone altogether during any period of intellectual activity. Emotional tone is always present and always changing, obviously so where, as in several of Prof. Gley's experiments, the intellectual work consisted in reading. Secondly, even if we could maintain a constant state of feeling, we should still be ignorant how far changes in the blood-circulation accompanying purely (!) intellectual activity are due to the aforesaid tendency of ideas to realise themselves in motor activity, and how far to physiological conditions essential for the manifestation of that intellectual activity.

The three remaining chapters of this interesting book are concerned with unconscious muscular movements, the muscular sense, and abnormalities in the sexual impulse. Embodying as they do material already published by the author some eighteen years ago, they hardly call for analysis here.

C. S. M.

OUR BOOK SHELF.

L'Éducation fondée sur la Science. By C.-A. Laisant. Preface by Alfred Naquet. Pp. xlv+153. (Paris: Félix Alcan, 1904.) Price 2.50 francs.

There is a special interest attaching to this book since it shows convincingly that those reforms which are being urged with such conspicuous success in this country are also engaging the attention, and calling forth the proselytising zeal, of French men of science. M. Laisant does not seem to have acquainted himself with the progress of English reform in mathematical teaching. Had he studied the reports of the committees of the British Association and the Mathematical Association, and had he realised the widespread alteration in the mathematical syllabuses of our public examinations, he could not have written :—" l'éducation anglaise, par exemple, est sur certains points (et surtout en ce qui concerne la géométrie), plus pitoyable encore que la nôtre, et elle semble avoir beaucoup plus pour objet de déformer l'esprit que de développer l'intelligence, lorsqu'elle impose la récitation par cœur du texte d'Euclide" (p. 73). The suggestions made in M. Laisant's discourse " L'Initiation Mathématique " for the improvement of mathematical teaching in French schools are not only familiar to our teachers, but are, we are glad to know, widely used by them.

Similarly, if we judge from the address " L'Initiation à l'Étude des Sciences physiques," it is clear that the necessity for the employment of experimental methods in the teaching of physics and chemistry is much more widely recognised with us than in France. One may go even farther and say that our practice is in advance of the ideal which M. Laisant places before his readers. We have learnt that the only really satisfactory way for a student to learn science is himself to enter upon simple experimental research work, and by his own efforts to demonstrate the truth of chemical and physical generalisations; M. Laisant seems to imply that experimental demonstration by the teacher may suffice.

It is possible here to refer only to a few of the interesting questions raised in the other two lectures—" Éducation scientifique et Psychologie" and " Le Problème de l'Éducation." We are heartily in agreement with M. Laisant that " il est certain que les classes peu nombreuses sont une des conditions premières et essentielles d'une éducation raisonnable" (p. 97), but since this means more teachers and a correspondingly larger national expenditure, we must wait in both countries for a greater belief in education on the part of the authorities. M. Laisant considers that " l'enfant est un être raisonnable; et le but le plus essentiel de l'éducation" is " de développer en lui la faculté du raisonnement" (p. 66). This is, however, not the general experience, and Spencer's is probably the wiser view that " only after an ample fund of observations has been accumulated, should reasoning begin."

The author's remarks on the teaching of morality and religion in schools will commend themselves to most men of science, who will agree that " l'éducateur habile, en stimulant dans l'esprit de son élève le culte de la vérité, en tirant parti de tous les exemples, de toutes les observations, de l'expérience quotidienne, arrivera sans peine à façonner graduellement cette conscience d'enfant pour en faire une conscience humaine" (p. 120).

A. T. S.

The Museums' Journal. Vol. ii. July, 1902, to June, 1903. (London: Dulau and Co.)

With the commencement of the present volume this important publication entered on a new phase of its existence, appearing in monthly parts instead of solely as an annual report. Although this change is undoubtedly for the better, it renders much of the contents of the complete volume rather ancient news, and some of the articles in the one before us have already received mention in our columns.

As regards the general condition of the Museums Association, it is satisfactory to learn that during the period covered by this report there has been a considerable increase of membership, both on the part of museums and of associates, and that this increase in the finances has been further augmented owing to the circumstance that several museums previously on the list have agreed to double their subscriptions in order to aid in defraying the increased expenditure inseparable from the monthly publication of the *Journal*.

As in the case of its predecessor, the contents of this volume cover a very wide field indeed, embracing everything connected with museums and natural history and art exhibitions, including their publications. A highly satisfactory feature is the amount of attention directed to rendering museums as interesting and instructive as possible to the general public, by whom they are maintained, and whose benefit should undoubtedly be their first aim and object. In connection with this subject we may especially refer to the article on the Haslemere Educational Museum, by Mr. E. W. Swanton, which, to judge from the appended plan, appears to be admirably designed and arranged for its purpose. In addition to general and local collections, this institution includes the almost unique feature of an aviary and a vivarium.

Whatever may be the case in this country, in America, as we learn from an article by Mr. F. C. Baker, the introduction of numerous well written descriptive labels in museums has proved a decided success. " Visitors," he writes, " have been seen to spend but a few moments examining cases installed by the old method, while a case containing some interesting material . . . will be pored over for several hours, which fact conclusively proves that the addition of carefully prepared descriptive labels is absolutely essential to the success and usefulness of a museum."

Labels in museums also form the subject of an article by Mr. F. A. Bather, who discusses certain difficulties in connection with the application of

vernacular names to specimens. Special reference is made to the case of the American bison, the author stating that no European naturalist could be prevailed upon to apply to that animal its Transatlantic title "buffalo." If, however, he will visit the mammalian gallery of the museum to which he himself belongs, he will find the label "Buffalo, in America" attached to the stand of one of the specimens of that species.

Lack of space alone precludes further reference to the contents of a volume which cannot fail to be of great value to all who have to do with museum arrangement. R. L.

Laboratory Physics. By Dayton Clarence Miller, D.Sc. Pp. xv+403; diagrams. (Boston, U.S.A., and London: Ginn and Co., 1903.) Price 8s. 6d.

THIS manual by the professor of physics in the Case School of Applied Science, Boston, is the result of twelve years of teaching experience, and most of the descriptions have been employed in type-written form for the past six years. It is not intended as a preparatory course; at the same time the majority of the experiments are of a fairly simple type. Constant references to existing text-books of practical physics (both English and American) show that the author has made free use of all sources of information, which is duly acknowledged. Many of the experiments are not usually met with in text-books, or at any rate are not met with in so full a form. Thus the complete calibration of a scale by Neumann and Thiesen's method is fully described (though without the theory, for which reference is made to Guillaume, "Thermométrie"), and there is an account of the use of Michelson's interferometer.

The author's aims are admirable. "A Laboratory course is not considered as consisting of a certain number of exercises to be worked out by each student, and to be complete when these are finished, but rather as consisting of a definite amount of time spent in judicious experimenting."

The descriptions of experimental details are good and are not overdone. The student will not be tempted to perform merely parrot work. He will require to think and scheme in many ways before his apparatus will prove tractable, and is not this just as it should be? We wish we could say that the days of organ-grinding were past.

No attempt is made to give even an outline of the *theory* of the experiments, and as the references are almost entirely to practical text-books, the student will require guidance in his choice of books from which the theory may be obtained. The manual would be improved if references to theoretic text-books were given as well.

The book is excellently printed and illustrated, and is very free from errors of all kinds. We notice only an erroneous definition of viscosity (p. 117), and the statement on p. 390 that $\pi/4 = 0.079577$, whereas this number is the value of the reciprocal of 4π.

Opere di Galileo Ferraris. Vol. ii. Pp. vi+473. (Milan: Ulrico Hoepli, 1903.)

THE memoirs included in the present volume may well be regarded as classical in the annals of applied electricity, since they belong to a period which has witnessed the birth and growth of the applications of electrical energy to lighting and power transmission. The first paper is an illustrated account, published in 1876, of the then "new induction machines," which, as the figures show, differed only in points of detail from the dynamo of the present day. This paper is followed by a series of five lectures on electric lighting, delivered in the spring of 1879, just about the time when, for the first time, the Piazza Colonna at Rome was brilliantly illumined by "Jablochkoff candles." The next 153 pages are occupied with a report by Prof. Ferraris on the industrial applications of the electric current, at the Paris Exhibition of 1881. In connection with that exhibition, we next have reports of the commissions appointed to deal with the determination of the ohm, atmospheric and terrestrial electricity, and the choice of photometric units. The subsequent contents comprise Prof. Ferraris's award of the prize offered in 1884 by the municipal government of Turin, reports on the Paris Exhibition of 1889 and the Chicago Congress of 1893, a discourse delivered before the Lincei Academy in 1894 on electrical transmission of energy, and an obituary notice of Gaulard, to whom as discoverer of the transformer Prof. Ferraris gives the highest praise.

Elements of the Theory of Integers. By Joseph Bowden, Ph.D. Pp. x + 258. (New York: The Macmillan Company; London: Macmillan and Co., Ltd., 1903.) Price 5s. net.

JUST as the names of plants and animals are constantly being altered, so the ranges of mathematical study included under such general titles as "Algebra up to the Binomial" or "Trigonometry up to Solution of Triangles" are changing as time goes on. In the "eighties," the average tripos candidate would understand by "elements of the theory of integers" the chapter in Todhunter's "Algebra" which taught him to "state and prove Fermat's theorem." The present book deals with nothing of this kind, but is devoted to proving such rules of algebra as that if $a > b$ then $b < a$, or $(-a)\times(-b) = +ab$. In the course of this work a number of cabalistic signs are introduced with which most mathematicians in this country are unfamiliar. Whether these symbols are necessary or even helpful must remain a matter of opinion, but there is no excuse for the author's incorrect spelling of the English language, as exemplified by "we hav," "ther ar," "therfor," "positiv," "canceld," "fixd," "giv."

Géographie Générale. By M. G. Lespagnol. Pp. vii+460. (Paris: Ch. Delagrave, 1903.)

THIS is an unusually comprehensive course, not of general geography as we know it in this country, but of physical geography, to which has been added a short history of geographical discovery and an essay on the growth of geographical science. The physical geography part of the volume follows the historical portions, and constitutes about three-quarters of the volume. A great deal of geological information is placed before the reader, much more than is commonly included in English books on physiography. The illustrations are numerous and generally good. There are many useful tables, and the book, as a whole, is a good introduction to an important subject. The absence of an index and a table of contents will be much regretted by students.

Pushing to the Front, or Success under Difficulties. By Orison Swett Marden. Pp. viii+416. (London: Gay and Bird, n.d.) Price 3s. 6d.

THE author's object in writing this book was "to encourage, inspire, and stimulate boys and girls who long to be somebody and do something in the world, but feel that they have no chance in life." Among the unusually large number of examples of distinguished men who have overcome successfully all sorts of difficulties, many great men of science are included, and Agassiz, Dalton, Darwin, Davy, Faraday, Franklin, Galileo, Humboldt, Huxley, and Hugh Miller may be mentioned. The book should certainly provide young men with an incentive to an increased effort to make the fullest use of their faculties and opportunities.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Radio-active Gas in Mineral Springs.

IN a letter to NATURE of August 13, 1903, it was announced that experiments carried out at the Blythswood Laboratory had shown the presence of a radio-active constituent in the gases derived from the mineral waters of Bath. An account of our further investigations has been given in a paper read before the Royal Philosophical Society of Glasgow, November 18, 1903. Samples of water from the Buxton springs have been tested with results exactly similar in character to those given by Bath waters. In both cases the ionisation-current through the gas obtained from the water increased to a maximum in about one hour from the commencement of an experiment, and then diminished to the normal value. In a note added to this paper, December 15, 1903, an experiment is described similar to one carried out by Mr. E. P. Adams (*Phil. Mag.*, vol. vi. p. 563, 1903). A current of air was drawn through a very dilute solution of a radium salt, and then through a Winchester quart containing distilled water. The air current was continued for two hours. The distilled water after this treatment was tested in exactly the same manner as the Bath water, "the results being in all respects similar. . . . It is therefore probable that the radio-activity of these (mineral) waters is due to the presence of radium near their source."

This anticipation has been confirmed by the Hon. R. J. Strutt's discovery of radium in the iron deposits left by the hot springs of Bath.

We have recently obtained conclusive evidence of the presence of radium emanation in the Buxton springs through the kindness of Mr. J. W. Wardley, who has collected samples of the gases that rise through the water and forwarded them to us for examination. In our former experiments with water sent from the springs the amount of gas obtained was extremely small, and the consequent activity inconsiderable. We now find that the activity of the gas falls to half value in about three and a half days, the corresponding time for the radium emanation being 3·71 days (Rutherford).

It would be interesting to know whether treatment by the gases obtained from the springs possesses any therapeutic value.

BLYTHSWOOD.
H. S. ALLEN.

Blythswood Laboratory, Renfrew.

Projection of Imitation Spinthariscope Appearance.

IN thinking over how to exhibit to an audience the appearance of a zinc-sulphide screen bombarded by radium, one of my sons suggested that a kinematograph film often imitated the effect, by reason of its punctures being thrown on the screen by intermittent light. Accordingly he made a model with two numerously punctured plates mounted on eccentrics so as to slide over one another in a periodic fashion. It is sufficient, however, to hold two punctured plates by hand in the place of a lantern slide, and move them irregularly over each other slowly.

OLIVER LODGE.

American Tropical Laboratory.

THE Director of Kew presents his compliments to the Editor of NATURE and requests the publication of the enclosed letter.

Kew, January 8.

New York Botanical Garden,
Bronx Park, New York City,
December 26, 1903.

My dear Sir William,

Referring to my letter of August 14, 1903, I take pleasure in stating that the group of buildings of the Colonial Government of Jamaica at the Cinchona Botanical Garden will be maintained as a botanical laboratory by the New York Botanical Garden under an agreement with the Colonial Government, and with the cooperation of the Department of Public Gardens and Plantations of Jamaica; sufficient land for experimental purposes and for a nursery is included in the leasehold privileges. The buildings include a residence known as Bellevue House, three laboratories, two ranges of glass, and one or two small buildings suitable for lodgings.

Investigators are offered the following facilities:—

(1) The use of tables in the laboratory buildings.

(2) Lodging in Bellevue House or in one of the other buildings at Cinchona.

(3) The use of land for experimental purposes.

(4) Privileges to study the plantations at Cinchona, and also those at Hope and Castleton Gardens.

(5) Privilege to consult the botanical library of the Department of Public Gardens and Plantations at Hope Gardens, and to take books therefrom to Cinchona under such conditions as may be imposed by the Director of Public Gardens and Plantations.

(6) An immense number of indigenous species are within easy reach in the primitive forests adjacent to Cinchona.

All persons who may apply for permission to study at Cinchona must submit such evidence as the Director-in-Chief of the New York Botanical Garden may require that they are competent to pursue investigation to advantage. While in residence at Cinchona they will be under the supervision of the Hon. William Fawcett, Director of Public Gardens and Plantations, to whose interest and advice the establishment of this American tropical laboratory is largely due.

A laboratory fee, payable to the New York Botanical Garden, will be required of persons granted the above privileges.

Upon approval by the scientific directors of the New York Botanical Garden, any other institution, society or individual may be assigned the use of a table at Cinchona by the payment of one hundred dollars annually, which will entitle them to nominate students desiring to avail themselves of the facilities of the laboratory for admission without the payment of fees, but not more than one person may be granted the use of any table at the same time.

The necessary expenses for a month's residence at Cinchona, including travelling expenses to and from ports on the Atlantic seaboard of the United States, are from 140 dollars to 200 dollars; for two months' residence 160 dollars to 230 dollars.

Dr. MacDougal will be glad to give you any further information concerning this subject that you may care for, and we hope that you or some of your students may be able to utilise the resources of the laboratory from time to time.

Yours sincerely,
(Signed) N. L. BRITTON,
Director-in-Chief.

Escape of Gases from Atmospheres.

IN the Literary Supplement of the *Times* of December 25, 1903, an erroneous statement is on p. 375 placed before its readers, to the effect that our alleged knowledge of the escape of some gases from the atmospheres of planets and satellites is based on an assumed absence of helium from the earth's atmosphere, and has been disposed of by the discovery that helium is present. A brief letter was addressed to the editor of the *Times* giving proofs that the above statement is incorrect, and from this letter an extract has been published as a note in the next number of the Literary Supplement. The matter concerns one of the great cosmical agencies of nature, and I therefore request you to allow me to deal with the subject in the more adequate way which is permissible when addressing a scientific journal.

The problem of the escape of gases from atmospheres has been approached in two ways, both of which the present writer has tried, and one of them has also of recent years been attempted by other scientific men:—(1) The problem has been treated deductively by ascertaining the law of the distribution of speeds among the particles of a hypothetical kinetic system, so constructed as to be a model of gas simple enough for human mathematics to enable us to compute the distribution of speeds within it, and which it was hoped

would sufficiently represent what goes on in the actual gases with which we have to deal. This expectation, unfortunately, has not yet been fulfilled (see *Proceedings* of the American Philosophical Society, vol. xlii. p. 108). (2) The problem has been treated inductively by arguing upwards from known facts of nature. It is in reference to this second method that the *Times* makes its statement.

So far from its being true, as was supposed by the *Times*, that the argument is based on the assumption that there is no helium in our atmosphere, it is pointed out in the first memoir upon the subject that there must be just such traces of helium and hydrogen in our atmosphere as have since been detected (see *Scientific Transactions* of the Royal Dublin Society, vol. vi. pp. 308 and 309).

The facts of nature which were made the data of the investigation are four in number. The first of these is *that there is either no atmosphere or very little on the moon*, from which it is inferred that the atmosphere which the moon shared with the earth when the two bodies separated, and whatever atmospheric gases have since been evolved upon the moon, have by this time escaped. It can be shown that if this be so, then hydrogen, if uncombined, must be able to escape from the earth. There is, however, but little *free* hydrogen upon the earth, and in the atmosphere there is only the merest trace. If there is in this trace any excess over what returns to the earth in rain or in other ways, this excess is on its way upwards towards the penultimate stratum of the atmosphere, which is the part of the atmosphere from which gases escape. Accordingly, the amount of hydrogen which succeeds in getting away from the earth must be very small, while the store of hydrogen locked up in the ocean and in the solid earth is enormous. It can, moreover, be shown that there is a minute accession of hydrogen to the earth from outside, so that on the whole the quantity of hydrogen upon the earth may be almost stationary.

The second and third facts used as data are that helium and free hydrogen are being continuously supplied from the earth to its atmosphere, and that—probably in both cases, certainly in the case of helium—only a very small percentage of the gross supply is being washed down by rain or in other ways returned to the earth, notwithstanding which *neither the hydrogen nor the helium has gone on accumulating in the atmosphere*. From this it is inferred that the quantity which is present in the atmosphere has adjusted itself to be such that the outflow of these gases from the upper regions of the atmosphere balances the net supply which the atmosphere receives from below.

One other fact in nature is used as a datum that the earth's potential of gravitation is sufficient to prevent any sensible escape of the lightest of the *abundant* constituents of its atmosphere. This lightest abundant constituent is the vapour of water.

A further paper has been published which is devoted specially to dealing with the behaviour of helium in the earth's atmosphere (see *Astrophysical Journal*, vol. xi. p. 369). In this paper it is shown from the marvellously accurate determinations made by Sir William Ramsay and his assistants that the supply of helium to the atmosphere by hot springs, and presumably the helium which oozes up elsewhere through the soil, is from 3000 to 6000 times more than can be accounted for as being a return to the atmosphere of helium which had been washed down by rain; whereas the argon, oxygen and nitrogen in such springs are all of them present in proportions which are consistent with their having been carried down by rain from the atmosphere. From which it is inferred (1) that nearly the whole of the small quantity of helium in the atmosphere is on its way outwards; (2) that helium would have become a larger constituent of the atmosphere by reason of the influx from below if there had been no simultaneous outflow from above; (3) that the rate of this outflow is presumably equal to the net rate of supply.

The escape of helium from a member of the solar system must be facilitated by the circumstances that those radiations from the sun that can affect helium have the full strength of radiation from the photosphere, inasmuch as the helium in the sun's outer atmosphere emits radiations of the same intensity as the photosphere. This is evidenced by the great helium line D_3 being as bright as the neighbouring part of the spectrum of the photosphere. We have, moreover, to take into account that outpour of corpuscles from the sun which, in the upper regions of our atmosphere, is able to excite into intense activity the internal motions of krypton which produce the green auroral line, and presumably with equal and perhaps increased vigour imparts energy to the molecules of helium which range to still greater altitudes.

G. JOHNSTONE STONEY.

30 Ledbury Road, W., January 7.

On the Origin of Spiral Nebulas.

THE ever increasing interest and importance of studies relating to celestial phenomena naturally lead up to questions which, in the present state of our knowledge, can (from the purely theoretical standpoint) in some cases be answered in a fairly satisfactory way.

The object of this note is to present certain views (some of which are believed to be new) on the probable origin of spiral nebulas, having given to start with an incandescent body like our sun.

From theory and observation we know that when different parts of the same fluid body have largely different temperatures the mass is in unstable equilibrium. The constant tendency of the resulting flow of the fluid is to equalise the temperature throughout the mass.

If the maximum temperature is in the interior of the body and the outside is exposed to a much lower temperature, the flow near the surface, through a gradual congealing of the latter, will be retarded. Such a surface will then also act as an insulator and shield to prevent both the too rapid loss of internal heat and the free escape of the accompanying gases.

The visible photosphere of the sun is known to be in a highly heated condition, and the fact that it is almost constantly being ruptured (in some zones more strongly and frequently than in others) shows—reasoning from analogy—that the solar surface has the properties of a fluid in such a state of unstable equilibrium that the superheated confined masses in the interior are still able to break through this surface at many points.

If the sun did not rotate on an axis, this surface would probably be of uniform strength throughout, for the interior circulation would then be radial. The resultant, however, of the rotary and radial forces acting on each particle produces not only an ellipsoidal figure, but also has the tendency to cause each ascending particle to move towards the equator.

As a result there is a tendency to produce surface-flow towards the equator causing an accumulation of cooled matter along the zone which but for this flow would be the weakest part of the whole rotating surface. It is therefore to be expected that two zones of least strength should exist in the solar surface, symmetrically situated with reference to the equator, but at some distance from it.

Now what is most likely to happen after a body like the sun has contracted to such a radius that the surface exists in the plastic or semi-solid state?

Such a surface will act as an insulator producing a more nearly uniform internal temperature and a consequent decrease in the interior circulation. The surface flow having ceased, and the axial velocity of rotation having increased, the zone of least surface-strength will coincide with the equator.

During the time required to reach this stage of the body's history it is probable that the lesser vents were gradually closed as the surface became stronger, resulting in periodic outbursts of increasing magnitude at a smaller number of openings until finally these also were closed.

As the *weight* of each particle of matter in the surface has increased inversely as the square of the radius (the sun's radius being unity), the internal pressure has been increased. Through the continued contraction of the outer surface this pressure, no longer relieved by periodic outbursts, increases far beyond the limit necessary to support the surface; as a result, the outer boundary grows hotter and consequently weaker, so that at last a great rupture of the surface takes place on or near the equator.

The moment this break occurs, the interior masses and

gases, which under great pressure have the properties of a fluid, move with various velocities, and along more or less curved lines toward the opening.

That component of the resulting momentum which acts at right angles to a diameter through the point of rupture causes an excess of pressure along this diameter; this excess, in the nature of a reaction, acting on a surface already strained to near the breaking point, finally causes a second rupture at the diametrically opposite part of the body.

The ejected masses will not all have the same velocity; those parts near the outer boundary of each stream will be deviated and retarded through side currents and friction at the aperture; the central parts of the stream will, in general, acquire the highest velocity, sufficient to carry the lighter matter in a radial direction far beyond the sphere of sensible attraction of the parent mass, where it finally attains a uniform velocity. The heavier masses and those near the borders of the opening will form secondary streams having various inclinations and velocities which, if there were no rotation, would be incomplete arcs of hyperbolas, parabolas and ellipses, in all of which the lighter masses would continually be outstripping the heavier ones.

Through the rotation, however, the outer parts of every stream are left behind the parts nearer the origin, so that each stream falls into a spiral curve of a more or less complicated form, resulting in an increase in the confusion of detail with diminishing distance from the centre.

If the orifices are on the equator, the radially ejected streams will be plain spirals. If the line joining the two orifices is inclined to the equator the streams will be of double curvature, each producing a spiral in the form of a helix[1] (conical). This class of nebulas not being confined to a single plane will, as a rule, exhibit much confusion of detail in projection.

In general a practically straight line drawn from the origin to any part of the plane spiral represents the actual path traversed by the matter in that particular part of the spiral, and the angular length of any given mass, measured in the direction of increasing distance from the origin, represents the corresponding arc through which the parent body rotated, in the opposite direction, while this particular mass was being cast out.

The two principal factors which operate to produce the observed form of any particular spiral are:—(1) internal pressure; (2) velocity of axial rotation.

The decrease in pressure, after the surface has been ruptured, may in some cases be so rapid that the orifices close up before the body has completed a single rotation; such a body will, later on, repeat the process, the orifices remaining open for a longer period; later still the surface will have reached such a condition that the orifices remain open for an indefinite period, finally reaching a stage represented (on a small scale) by the earth's present condition.[2]

If the earlier conditions were such that at the time of the first great eruption long ages were required for a single rotation of the body, the observed form indicates that the internal pressure remained nearly constant, and that the angular velocity was continually being accelerated. (Owing to the removal of heated matter from the interior the contraction was much more rapid than that which would have resulted from simple loss of heat at the surface.)

According to this theory, then, the spiral nebulas reveal to us the past history of the forces operating at the mouths of the two opposing volcanoes.[3] The fluctuations in the forces and in the relative amount of matter belched forth simultaneously by each crater are faithfully recorded in the often twisted, broken, serrated and irregular aspect of the masses which make up the general outline of the main hyperbolic spiral curves. This history covers the period from the first great catastrophe, represented by a distant large mass at the extreme outer limit of one branch, telling us which of the two orifices was the first to relieve the internal pressure, down to the time when the outer portions of the numerous inner streams having less initial velocity but the same angular length—or perhaps the outer portions of the main streams of a later eruption—reached to such distances from the centre as to produce too much confusion of detail for further trustworthy analysis of the form seen in projection.[1]

The generally more dense and more luminous inner boundary of the main spiral curves plainly indicates that after all these ages the lighter more swiftly moving but later ejected particles are still bombarding the earlier slower moving masses. Every time either orifice came nearly in line with, say, a particular distant previously ejected mass, the more swiftly moving particles were sent on their invisible course, many on the way transferring part of their energy of motion to other particles and to the production of the accompanying phenomena of heat and light; others to find free passage, leaving far behind those masses ejected in the same direction at previous rotations (thus crossing in radial directions the space between the main spiral arcs), finally to overtake, some to bombard the particular mass, thus helping to keep it luminous, others, like all parts of the main spiral, to continue their outward journey indefinitely, or until some other obstruction changes their energy of mass-motion into a different equivalent. Through the action of gravity the particles ejected by one body—aided by those coming from other sources—play their part to re-create the conditions leading to a repetition of the parental experiences.[2]

Isolated or heavier condensations on the spiral arcs will generally take on a cometary form indicating the direction from which the particles come. I would suggest that a long nebulous mass, as, for instance, H.V. 14 Cygni, may be a part of some great spiral (perhaps approaching and relatively near to the earth); if this is so, the general direction of the parent mass is plainly indicated in the visible structure of this nebula.

When the eruptions are periodic and of very short duration, the heavy surface-matter ejected at each re-opening of the craters will not be carried beyond the limits of the system. Certain results I have recently obtained seem to show that the masses forming star-clusters are the innermost parts of spiral structures similar to those considered in the present paper.

In the case of the great cluster in Hercules, the star-like masses are found to be connected by *nebulous streams which first leave then return towards the centre of the cluster*, showing that the initial velocity of ejection was insufficient to carry these masses (which can hardly be called stars in the ordinary meaning of the word) beyond the sphere of central attraction. A similar arrangement is found to exist among the stars near γ Cassiopeiæ. The two known nebulas near this star (first photographed by Barnard and Wolff) are but the more condensed parts of a broad spiral-like nebulous band (made up of similar condensations) which can be traced from near the middle of the second quadrant up to within a few minutes of arc of the naked eye star in the fourth quadrant. More complete details have been sent to the *Astronomical Journal* for publication.

In conclusion, it may be permitted once more to direct attention to a unique case in solar observation, bearing, as it does, directly upon the subject of the origin of spiral nebulas. How much, or rather how little, importance has been attached to this particular phenomenon, and to the "mechanical theory of comets"[3] put forward at the time,

[1] Photographs of these objects can be found in various astronomical publications. The most complete work in this line has been done by Isaac Roberts, D.Sc., F.R.S. See his "Photographs of Stars, Star Clusters and Nebulæ," vols. i. and ii.

[2] It is worthy of notice, in this connection, that the two most disturbed terrestrial regions are diametrically opposite to each other and near the equator. The deep-seated character of these disturbances is shown quite conclusively by the observed phenomena. Martinique belongs to one region, Krakatoa to the other.

[3] Spectroscopic and photometric changes in the light of certain fixed stars, when considered in connection with the phenomena which would be produced by two radially moving columns of matter (incandescent at the orifices and rotating about a fixed axis inclined at a given angle to the line of sight), might in some cases lead to more satisfactory explanations of the observed data.

[1] Through irregular variations in the pressure at the orifices, and through differences in the amount of matter ejected at different times, an endless variety of forms can be produced.

[2] Readers acquainted with Lockyer's views will notice that I adopt the theory of the meteoric constitution of nebulous matter. The evidences in favour of this theory are fully set forth in the work entitled "The Meteoritic Hypothesis," by Sir Norman Lockyer, K.C.B., F.R.S.

[3] See "Contributions from the Lick Observatory," No. 4, p. 118 *et seq.* This theory calls for just such crucial, seemingly abnormal but really typical phenomena as were presented by Borrelly's last comet.

is voiced in the language of one of the ablest descriptive writers on astronomical subjects of the present day. On p. 127 of her late admirable work entitled "Problems in Astrophysics," Miss Clerke dismisses the subject with the words, "*The only genuine 'eclipse comet' so far captured was that seen and photographed at Sohag 17th May, 1882.*" This talented writer makes not the slightest reference to the fact that the 1893 phenomenon differed in one important particular from all those it is said to resemble—that it possessed the one *observed* element which even the genuine object does not lay claim to, namely, the photographs prove that this object *moved*, receded from the sun through an angular distance equal to two-thirds of the solar diameter in less than four hours.[1] On the Mina Broncis photographs this object is plainly connected with the sun by a single, straight, isolated coronal stream.[2] J. M. SCHAEFERLE.

Ann Arbor, December 10, 1903.

Dynamical and Granular Media.

I SHOULD be very much obliged if any reader of NATURE who has studied the matter could enlighten me on the following point.

We may regard a *dynamical system* as commonly understood as being a system which, when left to itself, obeys the Hamiltonian equations

$$\frac{dx}{dt} = \frac{\partial U}{\partial \xi}, \text{ \&c.,} \quad \frac{d\xi}{dt} = -\frac{\partial U}{\partial x},$$

where $x, y, \ldots$ are generalised coordinates, $\xi, \eta, \ldots$ generalised momenta, and

$$U = \tfrac{1}{2}(\xi\xi)\xi^2 + (\xi\eta)\xi\eta + \ldots + V \quad \ldots \ldots \quad (1)$$

and V, $(\xi\xi)$, $(\xi\eta)$, &c., are any functions whatever of $x, y, \ldots$

We may regard a *granular medium* as a particular kind of system coming under this heading for which U takes the form

$$U = \Sigma \frac{\xi_r^2 + \eta_r^2 + \zeta_r^2}{2m_r} + \Sigma\Sigma_{rs} F_{rs}\{[(x_r - x_s)^2 + (y_r - y_s)^2 + (z_r - z_s)^2]^{\frac{1}{2}}\} \quad (2)$$

where m_r stands for any constant (being the mass of the rth particle, atom, corpuscle, grain, or whatever else you like to call it) and F_{rs} is any function whatever, continuous or discontinuous, determined by the law of force between different masses.

What I want to know is this:—

(1) Is every dynamical system which can exist in Euclidean three-dimensional space transformable into a granular system according to the above definition by a proper choice of coordinates?

(2) If not, what are the precise mathematical conditions under which a dynamical system can be so transformed?

We may put these questions in a somewhat different form. It is undoubtedly possible to conceive a universe the physical phenomena of which are represented by equations of any assumed form whatever, and therefore not necessarily by the equations of dynamics. Is it possible to conceive a universe the physical phenomena of which *are* represented by dynamical equations, but cannot be accounted for by means of a granular medium? I have read many treatises and essays dealing with theories of the ether, in which it has been tacitly assumed that the only possible answer to (1) must inevitably be "yes," and I cannot but feel that a discussion in your columns might be of much use to physicists.

G. H. BRYAN.

Phosphorescence of Photographic Plates.

I OBTAINED the following results, which are new to me, in the course of some experiments on the action of light on the salts of silver.

I have not yet thoroughly examined the light or radiation emitted in these experiments, but its actinic power is low, and it appears to render the brush discharge from an induction coil more luminous.

The sensitive silver salts, such as the bromide, iodide and chloride, if precipitated and kept in the dark, have the property, under certain conditions, of emitting light in degrees proportionate to their sensitiveness. Thus the bromide, which is the most sensitive, emits more light than the iodide and chloride. A convenient way of observing the phenomenon is to take a bromide photographic plate and place it at once (*without* having exposed it) in ordinary pyro soda developing solution and allow it to remain for ten minutes. Take out of the solution, wash, extinguish the "red lamp," and in total darkness plunge it suddenly into a dish containing a saturated solution of aluminium sulphate. The plate immediately becomes phosphorescent, and the solution also is luminous, but not so bright as the plate is at first. The light gradually weakens, and in a minute or two dies away. On pouring the solution off the plate into a bottle, the whole body of the liquid becomes luminous, and has the appearance of "bottled moonlight." It remains so several minutes, and the light is increased by shaking the liquid.

If half the plate be exposed to the action of white light for a second before treating with the pyro soda solution, that half remains dark and emits no light when the plate is put into the aluminium sulphate. If the plate is given a short exposure in the camera, and developed and put into the aluminium sulphate solution, the image will appear dark on a phosphorescent background.

On placing some precipitated bromide of silver (which had been kept a few days in a corked test-tube in the dark) in a porcelain dish and exposing it to a bright red light whilst adding the pyro-soda solution, it appears black, but on pouring off the solution the precipitate gradually assumes a bright green appearance under the red light, whilst in white light it appears dark grey or black.

The remarkable part of these experiments appears to me to be the fact that the exposing of the silver salts to the action of light destroys their power of emitting it under the treatment described, whilst the salt precipitated and treated in total darkness emits light freely.

T. A. VAUGHTON.

Ley Hill House, Sutton Coldfield.

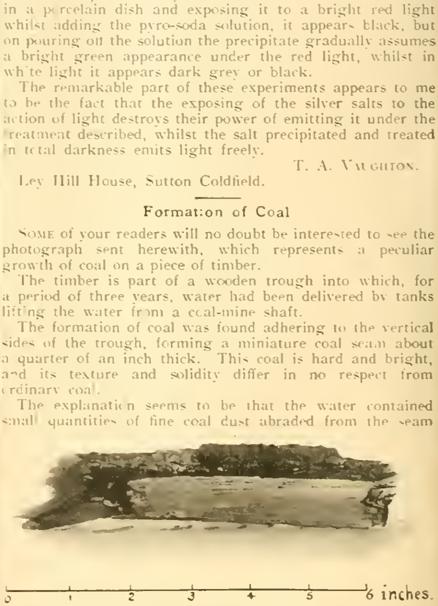
Formation of Coal

SOME of your readers will no doubt be interested to see the photograph sent herewith, which represents a peculiar growth of coal on a piece of timber.

The timber is part of a wooden trough into which, for a period of three years, water had been delivered by tanks lifting the water from a coal-mine shaft.

The formation of coal was found adhering to the vertical sides of the trough, forming a miniature coal seam about a quarter of an inch thick. This coal is hard and bright, and its texture and solidity differ in no respect from ordinary coal.

The explanation seems to be that the water contained small quantities of fine coal dust abraded from the seam



below, and these, either through the motion of the water or by some other means, were filtered out and formed anew into solid coal.

I believe this phenomenon has never previously been observed, and it appears to show that a coal seam may be broken up, washed away, and again built up in a new position without the aid of either the passage of time, pressure or heat. HENRY HALL.

Rainhill, January 3.

The Lamprey.

I SHALL feel obliged to any of your readers who will kindly tell me where to procure specimens of the lamprey. They are unobtainable at the Marine Stations of Millport and Plymouth. J. PENTLAND-SMITH.

St. Regulus, Park Place, Elie, N.B., January 5.

[1] See *Astronomical Journal*, No. [illegible]. Also Mr. Wesley's article in *Observatory*, No. 220, p. 349.

[2] See rough sketch in "Astronomy and Astrophysics," 1894, p. 397.

EARTH STRUCTURE.[1]

IN a copiously illustrated volume Mr. T. Mellard Reade, the well-known author of the "Origin of Mountain Ranges," expounds his views on certain geomorphological changes of profound interest to geologists. By tumefaction, wrinkling and denudation, the features of the face of our world are ever changing.

Evidences of the former activity by which regions of vast extent have been elevated or depressed almost vertically are, for example, found in raised sea beaches and submerged valleys. Fossiliferous rocks high up in mountain ranges, as in the Alps and Himalayas, attained their present positions by wrinkling during the process of mountain building.

Sedimentation results in the filling up of depressions, but its weight, no matter how mobile the undercrust may be, is not, according to the author, sufficient to raise neighbouring areas. Also it must not be overlooked that the phenomena presented to us represent pulsatory movements by which large tracts have been alternately raised and lowered. Secular contraction, inasmuch as it acts in one direction, does not seem adequate to explain these regional breathings. If by this and other well-known hypotheses we fail to explain vertical elevations and depressions, Mr. Reade invites us to consider the following.

We live on a rocky crust some thirty miles in thickness which rests upon a shell of igneous magma. By the expansion or contraction of portions of this magma due to changes in its temperature, tracts of the superincumbent crust are raised or lowered. The first question we are inclined to put relates to the manner in which these assumed variations in temperature are brought about. Blanketing by deposition of sediments the author regards as insufficient, but that there are such local subterranean alterations in temperature is evidenced by the shifting of volcanic centres and the intermittent activities of the same.

Variations in the character of lavas which have issued from the same vents, but at different times, indicate chemical and mechanical changes in a subjacent magma, and with such changes heat may be evolved or absorbed, and a magma may increase or decrease in its volume. Attention is also directed to the remarkable chemical and mineralogical alterations and the accompanying volumetric changes which have taken place in rock masses. With the phenomena of recalescence and magnetisation, alterations in bulk take place. In short, "the earth is not an inert mass cooling in space," but it is a planet within which there is flux and reflux, action and reaction, mechanical, chemical, and other activities in operation which result in the evolution of heat and alterations in volume, and in the latter we are to look for the cause of vertical elevations and depressions. References to the effect of these displacements in altering the level of oceanic water are made. The swelling or contraction of a magma beneath an ocean bed must result in a general rise or fall of water on the land.

The second form of geomorphic change considered is that which is due to a tangential creep and ridging of sediments due to fluctuating increases in temperature, and consequent expansion brought about by sedimentation. The wrinkles or mountain ranges on the face of the world are the results of such changes. With a falling temperature contraction sets in, strata shorten, and tensions result in faulting. By the faulting, wedge-shaped blocks fall inwards to act like keystones for the material on their flanks. The old theory that the features of the world are largely due to a shell accommodating itself to a retreating nucleus also accounts for the formation of the wrinkles by compression, but, unlike the theory advocated by Mr. Reade, it does not provide an explanation for normal faults which partition the roof of the world into block-like masses. That continental outlines are due to subsidences of the neighbouring oceanic basins, and are therefore sketched out by fault lines, is, according to the author, very doubtful; at all events, evidences of such dislocations, we are told, remain to be discovered. His own view is that for the most part such outlines are defined by mountain ranges, which represent thick accumulations of detritus derived from the denudation of land areas, lifted up by expansion on the platforms where they were deposited.

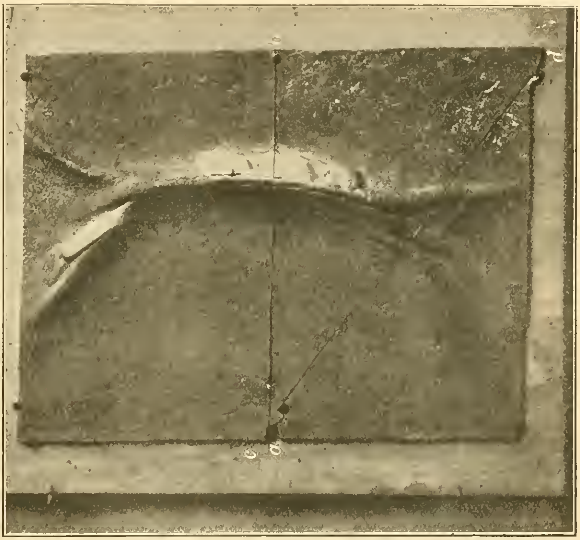


FIG. 1.—Showing cumulative effects of changes produced by hot and cold water upon a lead plate forming the lining of a pantry sink. A section along a, b, is shown in Fig. 2. (From "The Evolution of Earth Structure.")

A large section of the work refers to observations and experiments which throw light upon the foregoing hypotheses. The effects of end pressures as applied to layers of sheet lead, bars of soap, damp sand, and other materials are already fairly well known. An anticlinal rises near to the source of pressure, but the foldings are not altogether in accordance with those observed in nature. The effects of thrust are not con-

[1] "The Evolution of Earth Structure, with a Theory of Geomorphic Changes." By T. Mellard Reade. Pp. xv+342. (London: Longmans and Co., 1903.) Price 21s. net.

veyed to a sufficient distance, and Mr. Reade points out that, with similarly applied forces, something similar should occur in the earth's crust.

Results more in accordance with structures noted by the geologists are, however, seen in the effects of pressure originating in the general expansion of stratified material.

An observation bearing upon this form of action, which extended over many years, refers to the cumulative effects of changes produced by hot and cold water upon a lead plate forming the lining of a pantry sink. First it ridged up to form an overfold and eventually cracked. The fold was cut out, bent down, and soldered. In eight years' time the fold had again grown, little by little, by material imperceptibly flowing to the site of the fold, until it resembled the model of a mountain range.

The crescentic form of this ridge is seen in Fig. 1, the centre of the discs, but one on the right and the other on the left of a diameter. By placing cores upon the bed plate, or by deforming the bottom disc of clay upon which the other discs are placed, centripetal pressure results in anticlinals, spiral folding, various forms of shearing, and other structures, each being dependent upon the bias given by the form of the core, and it is to multilateral pressures akin to those employed in his experiments that the author ascribes many of the forms met with in mountain ranges.

Other interesting chapters relate to the effects of expansion due to atmospheric changes in temperature as exhibited by asphalt, cement, rails, and other substances, the production of slaty cleavage, and the supposed permanence of oceanic basins and continental domes.

The effects of denudation as a factor playing an important part in shaping the features of the world are

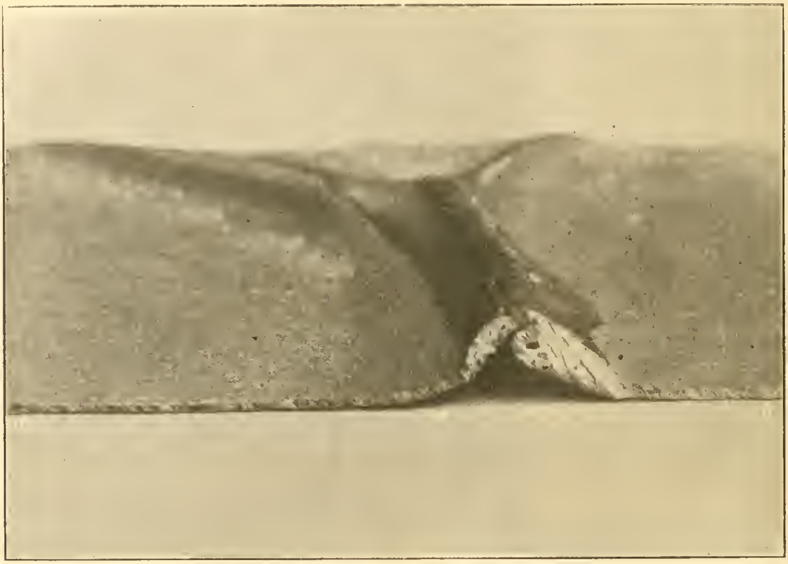


FIG. 2.—Photograph of section along saw-cut line a, b, Fig. 1, showing structure of the fold and overfold. (From "The Evolution of Earth Structure.")

whilst a section of the same through a, b (Fig. 2) shows that it had become an overfold. It is a form that could not be produced by external pressures, and as it so closely accords with the theory it is intended to illustrate, it well deserves the space, which is that of a whole chapter, devoted to its history.

Torsional structures, as, for example, those noted in the dolomites, and the curved axes of mountain ranges met with in nature, may be explained by multilateral or circumferential pressure, particularly when it is assumed that an initial bias is given by the form of the floor on which the strata have been deposited.

Experimental demonstrations of the effects of this form of pressure were made by compressing discs of clay confined by a circular metal loop, the diameter of which could be altered, much in the same manner that the diameter of a loop in a piece of string may be altered by pulling on the two ends. The ordinary effect of converging pressure is to produce doming, not in hardly mentioned, the reason being that they have already received so much attention from other writers. Mr. Reade deals almost entirely with activities which are hypogenic, and these, although some of them may be old acquaintances, he presents to geologists in a manner so novel that they acquire an importance which most certainly they did not previously possess. The ancient contraction theory is to be largely supplanted by one of expansion and contraction.

The amount of vertical movement asked for may be taken at 10,000 feet, or 1/2000 of the earth's radius —to human beings a quantity that is stupendous, but when regarded as a deviation in the smoothness of our globe it becomes a quantity that is insignificantly small. The author will no doubt find many followers; some may hesitate, but even those who have crystallised an ancient faith will pause to think and give to originality the consideration it deserves.

J. MILNE.

THE SANTA CRUZ FAUNA AND THE PRINCETON EXPEDITION TO PATAGONIA.[1]

IT is with the greatest satisfaction that we welcome the first-named instalment of an important work. The Santa Cruz Tertiary mammalian fauna is one of the most interesting and remarkable in the world, and we have now, for the first time, a guarantee that it will be described in a manner worthy of its importance. Hitherto this wonderful fauna has been but very scantily represented in museums outside of the Argentine, and in consequence students could gain only a very imperfect idea of its extent and affinities owing to the majority of the descriptions being of a more or less preliminary nature and inadequately illustrated. The acquisition by the Princeton Museum of the very large series of specimens collected by the expeditions to Patagonia under the charge of Mr. J. B. Hatcher from 1896–1899, together with a careful survey of all the other known collections, has now rendered it possible to publish full and adequate descriptions of all the more important types, and through the liberality of Mr. J. Pierpont Morgan the work will not be cramped for lack of illustrations.

In the introductory chapter, Prof. Scott, whose name is a sufficient guarantee for the excellence of the work, states that it has been decided to describe the specimens with a degree of detail which would be unnecessary in the case of forms well represented in museums throughout the world, and this detail will render his treatment of the work practically exhaustive. Some idea of the magnitude of the task will be gathered when we state that the present fasciculus of 106 4to pages is devoted entirely to the armadillos.

From the general character of the Santa Cruz fauna Prof. Scott is of opinion that Miocene Patagonia was rather an outpost of the South American fauna than the main area of its development. So far as the Edentates are concerned, this statement is justified by the apparent absence from the Santa Cruz horizon of representatives of the true sloths and anteaters, which, judging from the comparatively slight differences between the Santa Cruz Edentates and their Pampean successors, must almost certainly have been in existence at the epoch in question. This view is strengthened by the circumstance that many of the modern types of armadillos are unrepresented by ancestral forms in the Santa Cruz formation.

In general the Santa Cruz armadillos may be said to have attained the modern degree of specialisation, although in many details primitive features are retained. None of them, for instance, have an anterior solid shield to the carapace, which consists in most cases entirely of movable bands, although in certain instances a pelvic shield is developed. The most aberrant type is the horned Peltephilus, which has a full series of front teeth. The reference to this genus of a humerus of a somewhat monotreme-like type is not supported by the Princeton collection. Following the lead of other American zoologists, Prof. Scott splits up the Edentata into a larger number of family and generic groups than has generally been the fashion in this country, the number of such divisions being, of course, largely a matter of individual opinion. Prof. Scott, it will be noticed, has no hesitation in regarding the Santa Cruz fauna as of Miocene rather than of Eocene age.

The collection and description of the fossil mammals and birds, although the prime, was by no means the sole object of the expedition, and, according to a provisional scheme issued by the publication committee, it is intended to issue a full account of the zoology, palæontology, botany, and geology of the districts traversed. In this scheme it was proposed to complete the work in six volumes of about 500 pages each, and to do this within a period of four years. Apparently, however, this scheme proved inadequate, for in place of the botany forming a portion of vol. i., we find the sections before us constituting the first part of an eighth volume, the whole of the first being devoted to the narrative of the expedition and geography.

With regard to the botany, a very brief notice must suffice. The general characters of the vegetation of western Patagonia are described by Prof. Dusèn, who directs attention to the sharp demarcation between the evergreen and the deciduous beech-forests respectively characterising the two slopes of the Cordillera, and also between the whole forest tract and the Patagonian steppe. The Bryophyta are described by the same writer, but the Hepaticæ are treated by Mr. Evans and the Pteridophyta by Mr. Macloskie.

The bulky and beautifully illustrated volume devoted to the narrative of the expedition and geography teems with interest, but here, again, limitations of space prevent our doing justice to its contents. Perhaps the most generally interesting section is the one describing the Tehuelche Indians and their mode of life, which contains a number of most excellent portraits of these interesting tribes, as well as illustrations of the manner in which guanaco robes and other articles are manufactured. Judging from plate l., the Tehuelche girls are far from uncomely, but, as shown in the preceding plate, there is a sad falling off in personal appearance with advancing age.

So far as it is yet advanced, the work is an excellent example of the thoroughness of modern American treatment of scientific subjects. R. L.

[1] "Mammalia of the Santa Cruz Beds—1, Edentata, Dasypoda." By W. B. Scott. Rep. Princeton Exp. d. to Patagonia v., pp. 1–106; plates i–xvi. "Botany." part 1. By P. Dusèn, A. W. Evans and G. Macloskie. *Ibid.*, viii., pp. 1–138, plates i.–xi. "Narrative of the Expeditions and Geography of Southern Patagonia." By J. B. Hatcher. *Ibid.*, i., pp. 314, illustrated.

PROF. KARL ALFRED VON ZITTEL.

GEOLOGISTS and biologists throughout the world will lament the death of Prof. K. A. von Zittel, the accomplished palæontologist of Munich. For more than thirty years he had been acknowledged as the leading exponent of the science which is intimately connected with the progress both of geology and biology. For a still longer period his charming personality had combined with his wide reputation to attract to the Palæontological Museum at Munich students of the natural sciences from all civilised nations. Those who were unable to follow the prescribed university course were at least frequent guests, taking advantage of the unrivalled facilities for study and research among fossils which the professor's laboratories and collections afforded. So highly appreciated, indeed, was the school of palæontology in Munich that Prof. von Zittel soon began to experience the practical sympathy of several of his wealthy fellow-citizens, who had learned of his fame. In this manner he was provided with funds to equip expeditions and purchase collections of fossils beyond the means of most institutions of a similar character. The result was that the Palæontological Museum in the old Academy of Munich, already fine when von Zittel became professor, rose to preeminence among the museums of the European continent. It began to illustrate not only Bavaria and Europe, but every part of the world from which fossils were known; and as the collections were acquired, descriptions of all the important novelties were always quickly published, usually prepared by some student-graduate working under the professor's direction.

Prof. von Zittel had the advantage of beginning his great life-work at the early age of twenty-seven. Born at Bahlingen, in Baden, on September 25, 1839, he completed his education in the Universities of Heidelberg, Paris, and Vienna, and in 1863 he became teacher of geology and mineralogy in the polytechnic at Carlsruhe. In 1866 he succeeded Oppel as professor of geology and palæontology in the University of Munich. At this time he was interested in questions of stratigraphical geology, which depended much on the accurate determination and comparison of fossils. He had already written two important memoirs on the bivalved shells from the Cretaceous Gosau formation, which had been published by the Vienna Academy. He was then beginning to study the so-called Tithonian formation, on which he issued an important memoir in 1870, determining that it was equivalent to the Purbeck and Wealden formations of western Europe. These and other researches of a similar nature gradually impressed upon von Zittel the necessity for a fundamental revision of the whole science of palæontology, as it was then understood, and the preparation of a comprehensive treatise on the subject which could be used as a work of reference. He accordingly planned his now famous "Handbuch der Palæontologie," which was begun in 1876 and completed in four volumes in 1893, and this was the systematic basis of nearly all his future research. He thoroughly studied the fossil representatives of each group of the animal kingdom in order from the Protozoa to the Mammalia, and his original observations were not only incorporated in the "Handbuch" itself, but also formed the subject of many special papers and memoirs. Quite at the beginning of his task he met with unusual difficulties in the classification of the sponges, which necessitated his abandoning the projected treatise until he had devoted three years to his classical "Studien über fossile Spongien," which were published by the Royal Bavarian Academy between 1877 and 1879. Almost simultaneously with the early work of Sollas in the same direction, von Zittel devised a means of studying the fossil sponges in thin sections under the microscope, and his novel researches eventually led to a systematic arrangement of the Porifera, which has been confirmed in all its essential features by subsequent investigations of both extinct and living forms. Some of his memoirs related even to the Vertebrata, and those on the Chelonia and Pterodactyls from the Lithographic Stone of Bavaria (*Palaeontographica*, 1877, 1882) are especially valuable contributions to science.

On occasional excursions Prof. von Zittel still devoted himself to purely geological work, and among his published observations may be particularly mentioned those on the glaciation of the plain between Munich and the Alps, made in 1874 and 1875. Only in one instance, however, did he undertake researches of a geological nature on a large scale, namely, when he accompanied the Rohlfs Expedition to the Libyan Desert in 1873-74. The important results of these investigations were presented to the Royal Bavarian Academy as a "Festrede" on March 20, 1880, and a more detailed report (reprinted from the *Palaeontographica*) was issued as a separate work in 1883 under the title "Beiträge zur Geologie und Palæontologie der Libyschen Wüste." In this volume von Zittel's geological treatise was supplemented by a series of detailed descriptions of the fossils by Fuchs, Mayer-Eymar, Schenk, and other palæontologists.

The *Palaeontographica*, to which reference has been made, is a serial devoted solely to illustrated memoirs on fossils, founded by the eminent German palæontologists W. Dunker and Hermann von Meyer in 1846. From 1869 until his death Prof. von Zittel was its responsible editor. The Munich school was thus provided with ample means for publishing palæontological researches, and the editor's former pupils have for many years been the principal contributors to its pages. Although Prof. von Zittel himself was the main factor in the production of many of these memoirs, he always regarded his share as merely that of a helpful teacher, and did not overshadow the plodding student by adding his own name as joint author.

For the purposes of elementary or less specialised teaching the professor published a large and valuable series of lecture-diagrams of palæontology ("Palæontologische Wandtafeln," 1879–91), and as soon as his great "Handbuch" was finished he began at once to prepare an up-to-date epitome of it in one volume, which appeared in 1895 as the "Grundzüge der Palæontologie." Von Zittel also sometimes attempted more popular writings, such as his little readable volume on rocks and fossils, named "Aus der Urzeit," which appeared in 1872, with a second edition in 1875. This work contained some interesting maps of the distribution of land and sea in Europe during the various Mesozoic and Tertiary periods. His last essay of general interest was an address on "Palæontology and the Biogenetic Law," read before the International Congress of Geologists in 1894 and published in English in *Natural Science*, May, 1895.

The address just mentioned was almost the only occasion on which Prof. von Zittel ventured to express any opinions on the philosophy of biology or the solution of fundamental problems. Apart from his brilliant researches on sponges, indeed, scarcely any of his work can be regarded as suggesting important novel points of view. His "Handbuch" contains innumerable new facts obtained by personal observation, and they are accompanied by many proposed changes in classification or nomenclature, but only a small proportion of these emendations have proved acceptable to those who have pursued later research. His comprehensive treatment of palæontology has stimulated the progress of the science and has been of immense value, not because it suggests problems, but because it is a monument of judicious industry and thoroughness in the collection and presentation of the known facts. Von Zittel's "Handbuch" is indeed a trustworthy dictionary for reference rather than a guide to profitable lines of inquiry; and when the Americans, under the direction of Dr. C. R. Eastman, attempted a few years ago to infuse more philosophy into an English edition of the section Invertebrata of his "Grundzüge," Prof. von Zittel did not hesitate to express his dissent in conversation. A second edition of the first part of the "Grundzüge" has just appeared, in which none of the American palæontologists' changes are admitted. To understand the author's position it is only necessary to quote a sentence from his address of 1894:—"An important part is played to-day by subjective opinions, and when I think of the anxiety with which we elders—we who received our scientific education before the Darwinian era—proceeded to found a new species or genus, and compare it with the light-hearted manner in which to-day species, genera, families, and orders are set up and again put down, I am herein most forcibly impressed by the difference between then and now. The domination of the Linnæan and Cuvierian principles threatened systematic biology with soulless paralysis: the unbridled subjectivity of recent times may easily lead to anarchy."

A very striking instance of Prof. von Zittel's tireless industry in judicious compilation is his valuable "Geschichte der Geologie und Palæontologie bis dem Ende des 19ten Jahrhunderts," published by the Royal

Bavarian Academy in 1899. This volume was translated into English by the author's distinguished pupil, Mrs. Maria Ogilvie-Gordon, and issued in a slightly abbreviated form in Mr. Walter Scott's Contemporary Science Series in 1901. It will always remain a standard work of reference.

Prof. von Zittel naturally received numerous honours. Many years ago he became a Privy Councillor, and from 1899 until his death he was president of the Royal Bavarian Academy of Sciences. He was elected a foreign member of the Geological Society of London in 1889, and received the Wollaston medal in 1894. He was made a foreign associate of the United States National Academy of Sciences in 1898, and a correspondant of the Paris Academy of Sciences in 1900. His greatest joy was the ardent friendship with which he was honoured by his former pupils scattered through nearly all the civilised nations of the globe.

A. S. W.

NOTES.

The fifth International Congress of Zoology, held at Berlin in 1901, selected Switzerland as the place of meeting for the sixth session, and elected Prof. T. Studer president. In accordance with this resolution, the congress will meet at Bern from August 14–19 of this year. Prof. Studer, Bern, is president of the general committee, and the vice-presidents are:—Prof. E. Beraneck, Neuchâtel; Prof. H. Blanc, Lausanne; Dr. V. Fatio, Geneva; Prof. L. Kathariner, Fribourg; Prof. A. Lang, Zürich; Prof. E. Yung, Geneva; Prof. F. Zschokke, Basel; and Prof. R. Blanchard, Paris. The secretaries are Prof. M. Bedot, Geneva; Dr. J. Carl, Geneva; and Dr. W. Volz, Bern. The general meetings will be held in the Palace of Parliament at Bern, and the sectional sittings in the new university. During the congress there will be an excursion to Neuchâtel and to the Jura lakes, in order to visit the lake-dwellers' settlements. The closing meeting of the congress will be held at Interlaken. Afterwards the members of the congress will be invited to visit other Swiss cities. Communications or inquiries referring to the congress should be addressed to the president of the Sixth International Congress of Zoology, Museum of Natural History, Waisenhansstrasse, Bern. The congress is open to all zoologists and to all who are interested in zoology.

The *Atti* of the Lincei Academy announces the death, on November 25, of Angelo Maffucci, a member of the Academy since July, 1900.

A new Pasteur Institute has, says the *British Medical Journal*, been established at New Orleans, where the antirabic treatment will be carried out without any expense to the patients.

It is announced that Dr. Felix Kanitz died at Vienna on January 5. Dr. Kanitz, who was born at Budapest in 1829, was well known for his archæological and ethnographical labours in the Balkan peninsula.

It is reported that the Goodwin Sands lightships are to be put in communication with the shore by means of wireless telegraphy, and that the installation is to be completed in about a month. Four lightships will communicate with the Admiralty wireless telegraphy station near Shakespeare Cliff, Dover.

Lieut. E. H. Shackleton, late third lieutenant of the *Discovery*, and one of the three men who reached furthest south in a journey from the ship, has been appointed secretary of the Royal Scottish Geographical Society in succession to Lieut.-Colonel F. Bailey. Lieut. Shackleton had to be invalided home from the Antarctic on account of hæmorrhage of the lungs.

The death is announced of Dr. F. von Hefner-Alteneck, a member of the Berlin Academy of Sciences and a well-known engineer. Dr. von Hefner-Alteneck was born at Aschaffenburg in 1845. After studying at Munich and Zurich he entered the firm of Siemens and Halske, with whom he remained until 1890. He became chief engineer of the firm, and was the inventor of many electric appliances produced by that house.

The Geological Society of London has this year awarded its medals and funds as follows:—the Wollaston medal to Prof. Albert Heim, of Zurich; the Murchison medal to Prof. G. A. Lebour; the Lyell medal to Prof. A. G. Nathorst, of Stockholm; the Wollaston fund to Miss E. M. R. Wood; the Murchison fund to Dr. A. Hutchinson; the Lyell fund to Prof. S. H. Reynolds and Dr. C. A. Matley; the Barlow-Jameson fund to Mr. H. J. L. Beadnell.

Baron Erland Nordenskjöld, who left Southampton on January 6 on an expedition to Bolivia, informed a representative of Reuter's Agency that the expedition would last at least eighteen months, as he intended to penetrate the northern forests of Bolivia for the purpose of studying the hostile Indian tribes along the various tributaries of the Amazon, and the region to be traversed was practically unknown. He is accompanied by Lieut. D. de Bildt, a son of the Swedish Minister in London, and Dr. Holmgren.

At a meeting on January 5, the Bath City Council had under consideration a letter from the National Trust relative to the quarrying in the Cheddar Cliffs, and unanimously adopted the following resolution:—"That this council has heard with sincere regret of the damage which is being caused to the Cheddar Cliffs by the quarrying of stone therefrom, and other works connected with such quarrying, and trusts that steps may promptly be taken for preserving in its original condition, so far as practicable, this most picturesque and interesting feature of the West of England." Similar resolutions have also been passed by the Somerset County Council and other public bodies in the district.

Dr. Nordenskjöld and the members of his South Polar Expedition arrived at Hamburg on January 6. The unexpectedly early return from the South Polar regions of this expedition has, the *Times* states, enabled Dr. Jean Charcot to recast the plans of the French expedition on board the *Français*. He now proposes to explore the west coast of Graham Land and to carry out a very exhaustive scientific investigation of that region. From Flanders Bay, at the south-west end of Belgica Strait, Dr. Charcot intends to push south in the direction of Pitt Island and Adelaide Island, with Alexander Land as the great goal of the expedition's efforts. With the return of the Antarctic spring, if winter quarters have been taken up far enough south, Alexander Land will be the objective of these parties; otherwise the excursions will be undertaken with the object of linking up the work of the French expedition with that which Dr. Nordenskjöld and his companions have accomplished, working from the other, or eastern, side of the land masses in this part of the Antarctic region. It is Dr. Charcot's definite intention to return at the end of the season of 1904–5. The *Français*, indeed, is only provisioned for two years, and Dr. Charcot states that if the expedition does not return in the early months of 1905, it must be concluded that they have been involuntarily detained, and a relief vessel must be dispatched to their assistance.

THE Board of Education, in cooperation with the council of the Society of Arts, intends during the present year to hold, in the Victoria and Albert Museum, South Kensington, an exhibition of engravings produced by mechanical means, such as photogravure and other photographic processes, as a sequel to the exhibition of engraving and etching held during last summer; and as great advancements have been made in printing in colours since the Exhibition of Modern Illustration in 1901, specimens of colour printing will be included. A committee, of which Sir William de W. Abney, K.C.B., F.R.S., will act as chairman, has been formed to advise the Board in carrying out the exhibition. All communications should be addressed to the secretary, Exhibition of Mechanical Engraving, Board of Education, South Kensington.

AT the monthly meeting of the Church Society for the Promotion of Kindness to Animals, held on Friday, January 8, at the Church House, Westminster, it was resolved to present a memorial to the Government asking for a departmental inquiry into the conditions under which slaughtering is carried on, and the general treatment of animals. A paper was read on "Nature-Study Conducive to Kindness to Animals" by the Rev. Claude Hinscliff.

MR. J. A. GILRUTH, pathologist to the Public Health Department, Wellington, N.Z., is reported to have made a new discovery with regard to anthrax (*Times*, January 11). The series of experiments which he has conducted proves that an animal particularly susceptible to anthrax, such as a guinea-pig or a rabbit, will resist enormous doses of virulent anthrax provided the anthrax germs be mixed with a greater quantity of another species of microbe that in itself must be non-pathogenic and incapable of producing any disease. These observations may ultimately prove to be of practical importance, and their confirmation will be awaited with interest.

PROF. A. KLOSSOVSKY, of the University of Odessa, and director of the meteorological system of south-west Russia, has published in vol. xxv. of the *Journal* of the New Russian Society of Naturalists a very interesting *résumé* of the general condition of weather prediction at the present time. He deals with the old method of mean values and the modern method of synoptic meteorology, the application of mathematical analysis, with periodicities (varying from two to thirty-five, and even one hundred and thirty-five years), the moon's influence, &c. The chief object of the paper is to examine the method of M. Demtschinsky and the predictions published for some years in the journal *Climate*. The predictions in question have been submitted to an exhaustive examination, and Prof. Klossovsky's conclusions are entirely unfavourable to M. Demtschinsky's method and results. For the benefit of meteorological students the author suggests that, if M. Demtschinsky persists in his views, the matter should be referred to the independent decision of the International Meteorological Committee, and that the necessary funds should be placed at its disposal for the preliminary work of calculation and preparation of diagrams.

EVERY photographer who washes his negatives carefully is aware of the great expenditure of water and time required before he is satisfied that the last trace of hyposulphite of soda has been dissolved. Four hours is sometimes given as the length of time necessary, but usually one hour is considered sufficient. Mr. J. Norton, in the *British Journal of Photography* (January 1), suggests an alternative scheme for getting rid of the hypo in five minutes, and as he says he has given some attention to this question, his process may be summarised here. The basis on which the suggestion is made is that barium chloride has an exceedingly strong affinity for sulphur. On the addition of barium chloride to hyposulphite of soda both are immediately broken up; the barium unites with the sulphur and the soda with the chlorine, so that the products are barium sulphate and common salt. The barium sulphate being loose, very heavy, white (poisonous) powder, quite insoluble, can be easily rinsed off the photographs, and the common salt remains in the solution. After the photograph has been taken from the hyposulphite of soda solution, it should be rinsed in running water for a minute and rubbed on both sides with a cotton swab. It should then be dipped for two minutes in a 5 per cent. solution of barium chloride, and afterwards rinsed and swabbed in running water. Mr. Norton finds that five minutes is sufficient for this latter manipulation. He also remarks that the whites of the photographs are improved by this process.

Two small booklets on "Color Correct Photography" and "How a Lens Works," belonging to the "Photogram Series of Penny Pamphlets on Photography," have been received from the publishers, Messrs. Dawbarn and Ward, Ltd. The first contains some facts about isochromatic and orthochromatic methods which will aid the photographer to improve his work both from the technical and pictorial points of view. The second tells one what the lens can and cannot do, and gives in simple language various pieces of information useful to a beginner. This useful series of pamphlets will no doubt find many readers.

AN account of the development of mathematics during the nineteenth century is contributed by Dr. J. T. Merz to the *Proceedings* of the Durham University Philosophical Society.

IN a paper contributed to the *Physikalische Zeitschrift*, iv., 30, by Messrs. R. Luther and W. A. Uschkoff on the chemical action of Röntgen rays on bromide-gelatin photographic plates, the authors arrive at the conclusions (1) that the action of these rays is specifically different from that of ordinary light; (2) that short exposure to Röntgen rays alters the sensitiveness of the plates to ordinary light, sometimes increasing and sometimes decreasing it; (3) that previous illumination with ordinary light does not affect the behaviour of bromide plates towards Röntgen rays.

SEVERAL papers have recently appeared dealing with the study of ultra-microscopical particles. In the *Revue générale des Sciences* MM. A. Cotton and H. Mouton give a general account of the recent researches of Siedentopf and Zsigmondy, and Mr. E. Raehlmann, of Weimar, contributes to the *Physikalische Zeitschrift* the results of his researches on the ultra-microscopic particles contained in solutions of colouring matters, these researches having been carried out with the aid of the instrument belonging to the Zeiss Laboratory in Jena.

THE recent attempts of engineers and others to grapple with thermodynamical problems falling more strictly within the domain of the physicist have led to the publication of a paper by Prof. W. S. Franklin in *Science* for November 20, 1903, on the misuse of physics by biologists and engineers. In discussing irreversible processes, the author introduces the new nomenclature of "steady sweeps," "trailing sweeps," and "simple sweeps," and he maintains the view (rightly or wrongly) that the conception of *temperature* has no meaning except in cases of thermal equilibrium.

FROM the Gesellschaft für drahtlose Telegraphie we have received reprints of papers from the *Elektrotechnische Zeitschrift* dealing with a new detector for wireless telegraphy and a new measurer for electric waves. The detector, which is described by Mr. W. Schloemilch, depends on the property that when electric waves fall on a polarised electrolytic cell placed in circuit with a source of current of slightly higher E.M.F., the current in the circuit is increased either owing to a decrease of the resistance due to polarisation or from some other cause. The name "System Telefunken" has been given to this new method of wireless telegraphy.

IN *Science* for December 18, 1903, Dr. G. F. Kunz and Prof. C. Baskerville describe a series of observations made on the conduct of the gems and gem material of the Tiffany Morgan collection, and on several other collections of diamonds, under the influence of radium, Röntgen rays, and ultra-violet light. The fluorescence and phosphorescence were tested for more than 13,000 verified minerals. Seeing that three different kinds of radiation are considered, and that a mineral may respond or fail to respond to any one of them, the "number of ways" (to quote the familiar question on permutations) is eight, and the authors propose a tentative classification of minerals based on these eight ways. It is further pointed out that we have here a series of discriminating tests which may be readily applied to various minerals with the use of comparatively simple apparatus.

ON March 16, 1882, the late Prof. Adolfo Bartoli communicated a sealed packet to the Accademia dei Lincei, of Rome. This packet was opened at the meeting of the mathematical and physical section on February 1 of last year, and found to contain a paper on the transformation into electric currents of the radiations falling on a reflecting surface in motion. In this paper, which is published in the *Atti dei Lincei*, xii., 9, the author discusses a method, previously described, of conveying radiation from a cold body to a hot one by means of deformable reflectors, and among the various kinds of forces necessary to reconcile this result with thermodynamics, the author suggests pressure due to radiation, and the production of tangential currents when a reflecting surface is rotating rapidly in sunshine. It is interesting to note that the first explanation, which is now well established, led in Bartoli's time to no conclusive results, while his experiments clearly indicated the existence of the currents required for the second explanation.

A LIST of the flora of the Valle Anzasca (Macugnaga), on the Italian side of Monte Rosa, is given by M. Francesco Ardissone in the Lombardy *Rendiconti*. The valley in question, which is rarely if ever explicitly mentioned in botanical works, is remarkable for its large representation of the order Crassulaceæ, and in addition the author describes a new species of Androsace under the name *A. heterophylla*.

IN the *Memoirs* of the Boston Society of Natural History Prof. Jeffrey has published the first of a series of memoirs which will be devoted to the comparative anatomy and phylogeny of the Coniferæ. The genus Sequoia forms the subject of this paper, and considerable importance is attached to the distribution of the resin ducts. A similar distribution is found to occur in species of the genus Abies, whence Prof. Jeffrey is led to postulate the derivation of the living Sequoias from an abietineous stock.

THE experiment of fixing a seed to the side of a dish containing mercury so that the root of the seedling may force its way downwards into the mercury is a common one. It is not generally known that with certain seeds the penetration of the roots into the mercury may be effected without any fixation beyond the film of water which must be placed on the mercury to keep the root moist. In the *Proceedings* of the Amsterdam Royal Academy of Science Mr. P. van Harreveld discusses the controversies which have arisen out of this experiment, originally performed by Pinot in 1829. In a paper from the same source Dr. and Mrs. Th. Weevers bring forward evidence to show that alkaloids are formed synthetically in the young parts of such plants as tea, coffee, and cacao, and that in older parts they are wanting; the conclusion is that they are used up in metabolism.

HAVING regard to the present and future condition of the cotton industry in this country, very great interest attaches to the results of the trials which are being made to introduce the cultivation of cotton into our colonies. For the benefit of those disposed to take up cotton growing in the West Indies, the Imperial Commissioner of Agriculture has brought together in the last number of the *West Indian Bulletin* a series of articles dealing with the cultivation, chemistry and diseases of cotton. A point of primary importance is the careful selection of seed, for not only has the Sea Island cotton been improved by judicious selection, but the Rivers variety, which is resistant to the wilt disease, was obtained in the same way. Experimental plots were only started in St. Kitts, Antigua, Montserrat, and Barbados last year, so that it is too early as yet to obtain trustworthy data.

CAPTAIN STANLEY FLOWER has favoured us with a copy of the second edition of the "Guidebook" to the Zoological Gardens under his care at Giza, near Cairo. A brief account of many of the more interesting species in the collection is given. It is satisfactory to learn that the three specimens of the shoe-billed stork are still thriving.

THE January number of the *Entomologists' Monthly Magazine* contains several items of special interest. In one note Prof. T. H. Beare records the occurrence in two localities of a foreign beetle (*Ptinus tectus*) recently introduced into this country. The native home of this beetle is apparently Tasmania, but one of the introduced colonies came from the Levant. In another communication Mr. N. H. Joy records a Russian beetle, *Euconnus maeklini*, as British. Mr. W. E. Clarke, in recording several kinds of insects—chiefly moths—observed at the Eddystone Lighthouse, touches a practically new subject, namely, the wanderings and migrations of insects.

MR. P. W. STUART-MENTEATH has sent us a pamphlet on "Pyrenean Geology, part i., the Alpine Paradoxes" (Dulau and Co., 1903, price 1s.). This is a controversial essay on the structure of the Alps and Pyrenees, and on errors in the geological maps of those regions.

THE *Journal* of the Royal Microscopical Society for December, 1903, contains the usual summary of current researches relating to zoology and botany (principally Invertebrata and Cryptogamia), microscopy, &c., and in addition there is part xv. of Mr. F. W. Millett's report on the recent Foraminifera of the Malay Archipelago.

THE fossil echinoids of Japan have been described by Mr. S. Tokunaga (formerly Yoshiwara), the species being illustrated by four plates (*Journ.* Coll. Science, Tokyo, vol. xvii., art. 12, 1903). No echinoids have been found in the Palæozoic strata of Japan; the Mesozoic strata have yielded Pygurus, Toxaster, Cidaris, Pseudocidaris and Hemici-

daris (?); and eighteen genera are recorded from the Cainozoic series. Most of these last-named genera are still living, and some of the species have a wide geographical distribution and a considerable range in Tertiary time.

MR. A. LUCAS has prepared, for the Public Works Ministry at Cairo (1903), a report on the soil and water of the Wadi Tumilat lands. It appears that this alluvial tract formed part of "the land of Goschen," and was a fertile tract until ruined by the Ismailia Canal. The author points out that this high-level canal passes through a porous soil, and the seepage-water has not only raised the general level of the subsoil water, but has brought to the surface in many places salts of soda which have proved more or less injurious, the sodium carbonate being most harmful to vegetation. Wind also helps to distribute the efflorescent salts. The remedy consists in a thorough system of drainage, and in frequent washing of the land.

WE have received a copy of the "New and Revised Edition of a Geological Map of the Southern Transvaal," by Dr. F. H. Hatch (Stanford, price 20s. in sheet, 25s. in case), with explanatory pamphlet (1903). The scale of the map is a little more than four miles to an inch, and it includes an area bounded on the north by Pretoria, on the west by Ventersdorp and Klerksdorp, on the south by the Vaal River, and on the east by Greylingstadt and Heidelberg. It is very clearly printed in colours, and the farm boundaries are shown. Although admittedly a sketch-map, it will be of great service in representing the present state of knowledge with regard to the extent of the coal-bearing strata, the auriferous rocks and other mineral resources, not to mention the Dolomite series, which is economically of great importance as the source of perennial streams and as furnishing the present water-supply of Johannesburg.

SYSTEMATIC and distributional arrangements of the genus Polygonum in India have been prepared by Captain Gage, and are published in the *Records* of the Botanical Survey of India. The horizontal distribution of the species throughout certain sub-subareas of India compared with their distribution in other countries is well shown in one set of tables, and another set indicates the vertical distribution. From the latter it will be observed that *Polygonum viviparum* shows the greatest vertical range, namely, from 4000 to 17,000 feet; *Polygonum tortuosum* and *Polygonum sibiricum* reach to the same upper limit, but are not found below 11,000 feet.

IN the notice of "Le Point critique des Corps purs" in last week's NATURE (p. 217) it should have been stated that the author of the book is Prof. E. Mathias.

MESSRS. WATTS AND CO. have issued for the Rationalist Press Association sixpenny editions of "Science and Speculation," by Mr. C. H. Lewes, and of Mr. Edward Clodd's "Story of Creation." The latter volume contains eighty-six illustrations and tables.

THE Brin Oxygen Companies, the London address of which is now Elverton Street, Westminster, S.W., have issued a convenient little diary which is provided with much useful information. Not only are full particulars of the prices of the apparatus made by the companies and of the compressed gases supplied by them included, but also a series of hints to users of compressed gases in the form of medical notes, notes for lanternists, for blowpipe users, and on extreme refrigeration. In addition, the booklet contains a cylinder record and instructions for using liquefied carbon dioxide.

WE have just received an advance copy of Merck's English catalogue of fine chemicals. The list of chemicals is very comprehensive, and is probably the most complete published in this country. We note that Merck's present factory in Darmstadt will soon be replaced by entirely new works, now in course of erection.

IN the current number of the *American Journal of Science* Mr. J. C. Blake points out that soluble silver compounds are formed in the preparation of colloidal silver solutions by sparking between silver electrodes under water. It seems probable to the author that these compounds may play an important part in the peculiar actions exhibited by colloidal metal solutions, which, from the similarity of their behaviour to that of ferments, have been styled by Bredig inorganic ferments.

IN the *Proceedings* of the American Academy of Arts and Sciences Mr. G. P. Baxter describes some further experiments relative to the atomic weight of iron, an entirely new method—the analysis of ferrous bromide—being employed. These new experiments confirm the result, 55·88, previously obtained by Richards and Baxter for the atomic weight by the reduction of the oxide, and indicate that the value, 56·0, usually employed is appreciably inaccurate.

A NEW form of electrical resistance furnace was described by Dr. Frölich at the last meeting of the German "Bunsen" Society for Applied Physical Chemistry. Instead of employing carbon cores as the immediate source of heat, the sides of the furnace itself are utilised, the furnace being constructed of some specially suitable material the nature of which has not been divulged. The mean temperatures reached in a core furnace and in that described by the author under comparative conditions were found to be 1200° and 1600° C.

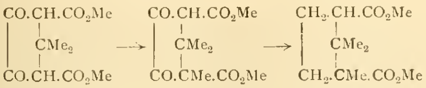
THE first number of a new review, the *Physikalisch-chemisches Centralblatt*, has just been issued. It is not intended as a medium for the publication of original work, but as a comprehensive centralising review of progress in physical chemistry, the extraordinarily rapid rise and development of which during the last decade is almost unique in the history of science. The abstracts are to appear either in German, English, or French, and, so far as possible, will be furnished by the authors themselves. The review will be issued twice a month, and will no doubt be a valuable aid to the numerous chemists who desire to keep abreast of physicochemical literature.

THE oxidation of phosphorus is a reaction which, in spite of its apparently simple nature, exhibits many anomalies. The rate of oxidation increases as the pressure diminishes, and no completely satisfactory explanation of this apparent exception to the law of mass action has yet been given. In the current number of the *Journal* of the Chemical Society Mr. E. J. Russell contributes a further series of observations on the subject. It appears that the presence of a small quantity of water is necessary for the oxidation, and that the quantity left after drying with sulphuric acid is that which allows reaction to proceed most rapidly. The results of experiments carried out at higher pressures contradict the usual statement that phosphorus only reacts with oxygen at low pressures, and the author finds that the reaction in these circumstances is in agreement with the mass action law.

A NOVEL reducing agent is described by Dr. Stoermer in a recent number of the *Berichte*. He has found that in a considerable number of cases compounds containing the group $-CH_2.CO-$ are reduced by heating with phosphorus

tribromide to unsaturated compounds containing the group —CH : CH—. Thus desoxybenzoin, $C_6H_5.CH_2.CO.C_6H_5$, is reduced to stilbene, $C_6H_5.CH : CH.C_6H_5$, and diphenylpyrazolone to diphenylpyrazole. The method is also applicable to some compounds containing the group —NH.CO—, and carbostyril is in part reduced by phosphorus tribromide to quinoline.

The long sought synthesis of camphoric acid has been recently accomplished by Dr. Komppa, of Helsingfors (Finland), and is described in the *Berichte* of December 29, 1903. Two years ago the author described the synthesis of apocamphoric acid, which differs from camphoric acid only in the presence of a hydrogen atom in place of one of the methyl groups. The methyl group cannot be introduced directly into apocamphoric acid, but the diketo-apocamphoric ester can be methylated and yields a diketocamphoric acid which can be indirectly reduced to camphoric acid,



The synthetical acid is optically inactive, but proved to be identical with the known racemic form of camphoric acid. The synthesis includes also the preparation of camphor from its elements, since the conversion of camphoric acid into camphor was accomplished some years ago by Haller. Although the correctness of Bredt's formula for camphor has been fully established by the synthesis of several of its oxidation products, the synthesis of the ketone itself has for some years been one of the most attractive problems in organic chemistry, and its solution completes a not unimportant chapter in the history of chemical progress.

The additions to the Zoological Society's Gardens during the past week include a Raven (*Corvus corax*), British, presented by Mr. George Ogilvie; a Mongoose Lemur (*Lemur mongoz*) from Madagascar, two Sulphury Tyrants (*Pitangus sulphuratus*) from South America, deposited; a Llama (*Lama peruana*), born in the Gardens.

OUR ASTRONOMICAL COLUMN.

Distribution of the Stars.—No. 5, vol. xlviii., of the Harvard College Observatory *Annals* contains a discussion of the distribution of the stars throughout the whole sky. A special point of the discussion was to determine the relative numbers of the stars situated in the Milky Way and those outside its limits. The number of stars in the galaxy was determined from the charts given in Heis's atlas and the Uranometria Argentina; those without were determined from the Harvard Durchmusterungs. Twenty-three tables included in the paper set out the various results in detail, but the following are among the chief facts determined.

The number of stars in a given area of the Milky Way is about twice as great as in an equal area of any other region, and this ratio does not increase for faint stars down to the twelfth magnitude; the proportion of stars of any given magnitude is the same in the Milky Way as in the other regions. The Milky Way covers about one-third of the sky, and contains about half of the stars. There is no evidence of any limit to the faintness of the stars, although the proportionate increase becomes less for each successive magnitude. There are about 10,000 stars of magnitude 6·6 or brighter, 100,000 of magnitude 8·7, 1,000,000 of magnitude 11·0, and 2,000,000 of magnitude 11·9. Although uncertain, it is suggested that there are about eighteen millions of stars visible in a telescope of 15 inches aperture, *i.e.* down to about the fifteenth magnitude.

The distribution of various spectral types has also been considered, and the most striking fact is the preponderance of stars of class "A" and "K" (Harvard), which in a general classification may be taken as typical spectra, the others being simply modifications of these. Many other extremely interesting facts have been elicited during the discussion, but they are too numerous to mention here.

Report of the Windsor, N.S.W., Observatory.—Mr. Tebbutt's report of the work performed at this observatory (Windsor, N.S.W.) during 1902 deals chiefly with meridian observations for the determination of local time and star places. Most of the extra-meridian work mentioned has already been published in the *Astronomische Nachrichten*, and includes observations of minor planets (for positions) and Perrine's comet (1902 *b*). The reduced measures of fifty-four of the double-stars given in Innes's "Reference Catalogue," involving 1757 settings for position angle and 1503 for distance, have been communicated to the Royal Astronomical Society. The local meteorological results, given in the report, include monthly returns of temperature and rainfall observations, and show that the number of inches, recorded by a rain-gauge placed about 7 feet above the ground, is less than for any year since 1863, being, in fact, about 14·5 inches below the average for forty years. A number of comparisons of the temperatures recorded by two thermometers, one in a Greenwich the other in a Stevenson screen, showed that an excess amounting to between one and two degrees was registered by the former.

A French-Chinese Calendar.—The "Calendrier Annuaire" for 1904, compiled at the Li-Ka-Wei Observatory, and published at the price of one dollar by the Catholic Mission at Shanghai, is an interesting calendar containing many astronomical, meteorological and physical tables.

The calendar is printed in French, but all proper names and technical terms are also given in Chinese characters and words. Among the more important matters dealt with there occur a lucid explanation of the Chinese calendar, many astronomical tables and explanatory notes, tables for the conversion of Chinese and Japanese standards into European equivalents, facts regarding the population, area and political relations of China, and a number of tables and curves relating to the meteorology of the Chinese Empire.

A Bright Bolide.—A remarkable bolide was observed by Mr. W. E. Rolston at Fulham at about 8h. 27m. p.m. on January 9. It appeared at a point situated at about $\alpha = 102°$, $\delta = +18°$, and slowly travelled towards the constellation Cancer, leaving a bright, scintillating, reddish trail. When near to the point $\alpha = 112°$, $\delta = +18°$ (approx.) the head slowly swelled out into a bulbous shape having a yellowish-red hue, became considerably brighter than Jupiter, and then suddenly disappeared. The duration of the complete phenomenon was about five or six seconds.

THE PHYSICAL LABORATORY AT LEYDEN.

An account of this laboratory, published in Nature of August 13, 1896 (vol. liv. p. 345), dealt with the inception of the cryogenic department in 1883, and traced its development up to date. It is the purpose of this note to continue the account to the present time, both as regards the more important changes and improvements in the cryogenic department itself, and also in the remaining divisions of the laboratory.

As before, the communications continue to give an almost complete account of the results of the practical work carried out, together with certain more theoretical papers in direct connection with this. Since 1898, the Royal Academy of Amsterdam has published its *Proceedings* in English as well as in Dutch, so that the communications are now corrected reprints of the *Proceedings*. Some idea may be gathered of the increasing output of work when it is noted that in 1896 the current number of the communications was twenty-three, while it has now risen to eighty-eight.

This increasing productivity is mainly due to the much improved appliances, both for manipulation and measurement, which have been developed during the last ten years. Although the original system of three main cycles containing methyl chloride, ethylene and oxygen has been retained, almost every part has been improved and enlarged, so that the ease and rapidity of working are much enhanced. In

addition several auxiliary circulations have been constructed in order to add new ranges of temperature to those already obtainable by the main cycles, or at least to make certain temperatures more practicable. Of these the principal are:—(1) a circulation of strong calcium chloride solution cooled to about $-23°$ C. by methyl chloride, and then heated again to the required constant temperature in a thermostat; (2) a nitrous oxide circulation, also in connection with the methyl chloride, for temperatures about $-90°$ C.; (3) air; (4) nitrogen; and (5) methane in connection with the oxygen cycle. In this way the entire range between $+5°$ and $-210°$ can be covered with but few gaps.

The efficiency of the circulations is now very high, as each step in the cascade only lasts about 20 minutes, so that liquid nitrogen even, which requires four operations, is obtained in 1 hour 20 minutes. For this purpose about 6 kg. methyl chloride, 1·3 kg. ethylene, 2·5 kg. oxygen, and 1·0 kg. nitrogen are required, with the pumps running at about 5, 6, 30, and 6 atmospheres pressure in the respective cycles. In order to obtain this speed of work a new large Burckhardt-Weiss pump, with a capacity of 100 litres per second and capable of evacuating to 2 mm. of mercury, has been introduced before the vacuum cylinder of the Pictet conjugated pump in both methyl chloride and ethylene circulations. In the case when a bath of liquid nitrogen is required, one of the two Brotherhood compressors is put into the oxygen circulation, while the nitrogen is compressed in the modified Cailletet pump mentioned before, after passing through an auxiliary pump, to bring it to about 10 atmospheres pressure.

Two methods are employed for conveying the liquid gas required from the cryogenic room to one of three experimenting rooms. Where many measurements at a reduced temperature are desired, hence necessitating a frequent addition of liquid, methyl chloride, nitrous oxide, and ethylene have been conveyed in a copper tube well wrapped up in wool and paper for a distance of about 10 metres. In other cases the liquid is run into specially mounted vacuum glasses, which are transported to the experimental vessel, into which the liquid is siphoned over. Measurements have been made in this way with all the gases mentioned, in vessels which require the use of litres of liquid.

One of Prof. Onnes's chief objects in founding his cryogenic department was the experimental determination of accurate isothermals of pure elementary gases and their binary mixtures, at temperatures near the critical. Although measurements had been made on methyl chloride, carbon dioxide, and mixtures of these with oxygen or hydrogen, no measurements on the latter gases alone had been attempted until about four years ago. The first necessity was a standard open mercury manometer for the very accurate determination of pressures up to 64 atmospheres. Since this has been available, measurements have been made on hydrogen, oxygen, and nitrogen at ordinary and at low temperatures to an accuracy unattained before in such work. At the same time very careful comparisons have been made between the expansion coefficients, at constant volume, of the same gases at low temperatures. In order that these measurements should be possible, it was also necessary to develop the system for the determination of temperature to the accuracy required. For this purpose use has been made of constant volume hydrogen thermometers and of specially prepared and calibrated platinum resistances or thermoelements.

For the most recent measurements it has been found advisable to employ, at the same time, both a temperature indicator and a temperature measurer. The measuring instrument must be sensitive enough for the accuracy required, but the indicator must be set to a higher order. A combination of a platinum resistance, wound upon glass and surrounding the experimental tube, with a thermoelement has usually been employed.

The temperature of an evaporating liquid varies both from the want of homogeneity of the substance and of constancy in the pressure. By suitable adjustment of the pressure, it is possible to make these variations compensate one another, with the result that a nearly constant temperature is obtained. In the thermoelectric circuit variations of 0·01 degree can be immediately seen and corrected by a suitable small change of pressure. Variations due to the pumping machinery and other similar causes are corrected at once from the indications of an oil manometer. In addition, continual stirring by a small motor allows temperatures down to $-210°$ C. to be obtained, which remain constant and uniform to 0·01 degree for an hour in baths 15 cm. in depth.

Preparations are now being made, by the addition of new pumps and other apparatus, for the installation, on the same principles, of a hydrogen cryostate, which will allow of the extension of the range of constant temperatures to the boiling point of hydrogen under reduced pressure.

Since only minor technical difficulties are to be expected, it is probable that this cycle will be completed in a few years' time.

During the past decade several other important investigations have been made. Of these the best known is certainly the discovery and measurement by Dr. Zeeman of the effect which goes by his name. This was largely due to a set of careful experiments and measurements on kindred optical questions, and was tried several times without success. Immediately it was noticed Prof. Lorentz was able to supply the elementary theory, which has subsequently only been elaborated. The discovery thus belongs peculiarly to Leyden, while the partnership was fittingly acknowledged by the joint award of the Nobel prize in 1902.

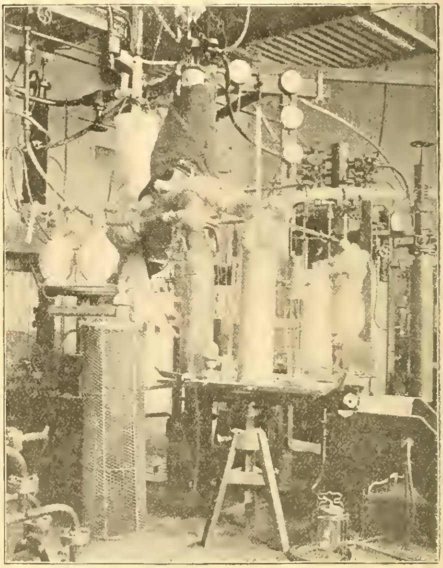


FIG. 1.—The immediate apparatus for the preparation of liquid nitrogen or methane. The liquefied gas is being collected in the metal cylinders in middle of picture. This apparatus stands at the end of the room from which the view shown in 1896 was taken.

What Prof. Onnes considers as to some extent a new method of thermodynamical research has been recently developed by him. It consists in making large accurate models of both the Gibbs (ϵ, η, v) and van der Waals (ψ, v, x) surfaces. By means of these many problems can be treated with comparative ease, which otherwise would either be impossible or would involve very lengthy calculations.

The following list of the principal researches from the beginning of the communications will show clearly the range of work covered.

To make it a continuation of that in the former note the same numbers have been retained :—

(1) Cryogenic department. Pumps, cycles, experimental apparatus, &c. (Nos. 14, 23, 51, 54, 85).

(2) Investigations regarding condensation of mixtures (Kuenen, Nos. 4, 7, 8, 11, 13, 16, 17; Hartman, Nos. 43, 56, 64, Supplement 3; Verschaffelt, Nos. 45, 47, 55, 65; Keesom, 88).

(3) Measurements on capillarity (de Vries, No. 6; Verschaffelt, Nos. 18, 28, 32; van Eldik, No. 39).

(4) Measurements on viscosity of methyl chloride (Stoel and Haas, Nos. 2, 12).

(5) Experiments on Kerr's magneto-optical phenomenon (Sissingh, Wind and Zeeman, Nos. 1, 3, 5, 8, 9, 10, 15, 20); on the influence of magnetism on light (Zeeman, Nos. 29 33. 36).

(6) Measurements of the Hall phenomenon in bismuth (Lebret, Nos. 15, 19; van Everdingen, Supplement 2, 61, 63. 72).

(7) On Hertz waves in water and electrolytes (Zeeman, Nos. 21, 22, and with Cohn, No. 30).

(8) The dispersion of the magnetic rotation in gases and liquid gases (Siertsema, Supplement 1, Nos. 62, 73, 76, 80, 82).

(9) The accurate measurement of very low temperatures (Kamerlingh Onnes, Nos. 27, 44, 50, and Boudin, No. 60, and Heuse, No. 87; Meilink, No. 77).

(10) Dielectric constants of liquid gases (Hasenoehrl, No. 52).

(11) Accurate isothermals and critical constants of diatomic gases (Schalkwyk, Nos. 67, 70; Kamerlingh Onnes and Hyndman, Nos. 69, 78, 84).

(12) Contributions to the knowledge of van der Waals's ψ surface (Kamerlingh Onnes, Nos. 59*a*, 66, and Reinganum, No. 59*b*, and Happel, No. 86; Keesom, Nos. 75, 79; Verschaffelt, No. 81).

(13) The expression of equations of state by means of series (Kamerlingh Onnes, Nos. 72, 74).

In addition, measurements have been made at low temperatures, and will be published shortly, relating to the pressure coefficient of oxygen and nitrogen at both ordinary and high pressures, and also to the critical phenomena and constants of oxygen.

At the present time the electrical installations of the laboratory are being largely increased. There are already three dynamos which can give a current of 200 amperes at 120 volts, and two motors will be ready shortly to drive some of the pumps and other apparatus.

The possibility of making and fitting the highly specialised and intricate apparatus required for some of these measurements is largely aided by the circumstance that the laboratory is combined with a technical school for instrument making and certain branches of electrical technology. About twenty apprentices are at present passing through the wood, metal, and glass workshops, each of which is controlled by a skilled workman. In this way the construction and repair of apparatus, and the help required for complicated experiments, can be obtained in a most satisfactory manner. This unique combination of research laboratory and technical school is well worth a visit from physicists touring in Holland, who will receive a friendly welcome from Prof. Onnes.

H. H. F. HYNDMAN.

AUSTRIAN GEOLOGICAL SURVEY.

SOME important publications of the Austrian Geological Survey have reached us, namely, the first part of the twentieth volume of the *Abhandlungen der k.k. Geologischen Reichsanstalt*, Vienna (1903), the second, third and fourth parts of the fifty-second volume and the first part of the fifty-third volume of the *Jahrbuch* (1902–1903).

The first of these works is a valuable memoir by Ernst Kittl, on the Cephalopoda of the Upper Werfen beds of Muć, in Dalmatia, and other localities, and comprises seventy-seven pages and eleven plates. As indicated by the title, the greater part of the material described in this memoir was obtained from the locality discovered in 1862 at Muć (or Much), in northern Dalmatia, but some of the specimens are from other areas, including certain Alpine localities. Some account is given of the various places where similar strata have been met with, and numerous references are made to the writings of other workers. The description of the various genera and species constitutes the bulk of the work. All the forms noticed are included in two families :—(1) the Ceratitidæ, with the genera Dinarites, Stacheites, Ceratites, and Tirolites; and (2) the family Pinacoceratidæ, with the genera Kymatites, Meekoceras, and Dalmatites. Of these genera Stacheites alone is new to science, but certain subgenera and thirty-four species are described and named for the first time.

In conclusion, the author directs special attention to the importance of the few precursors of the Muschelkalk Cephalopoda, such as Dalmatites, Ceratites, and some nearly allied forms, which are now for the first time known to occur in the Werfen beds.

A comparison with the Permian and Carboniferous fauna of Silesia, Russia, and India shows the comparative poverty of the Werfen beds, and the author points out that the scanty fauna goes "hand in hand" with the small amount of calcareous matter in the deposit.

The second part of the *Jahrbuch* indicated above contains several interesting papers on various subjects, each being illustrated by plates or text figures. Dr. Karl Hinterlechner describes the petrographical characters of some rocks from the Cambrians of western Bohemia. The "Erzberg" in Hüttenberg, Carinthia, is described by Bruno Baumgärtel; Dr. Rudolf Zuber gives us some new studies in the Carpathians; while Hermann Bock supplies an account of the physical structure of the neighbourhood of Brünn. Then follow three palæontological papers :—Rich. Joh. Schubert, on some bivalves from the Istro-Dalmatian "Rudistenkalkes"; Vincenz Hilber, on some fossils from the Gosau beds of Kainach and Söding, in the northern parts of Voitsberg—in this paper one new species is described under the name of *Hippurites Styriacus*; Adalbert Liebus and Rich. Joh. Schubert describe the Foraminifera from the Carpathian Inoceramus beds of Gbellan, in Hungary, seven new species and four new varieties being named. The concluding paper, and certainly not the least important, is by Dr. H. Graf Keyserling, and is entitled "Geologico-petrographical Studies in the Region of the Melaphyre and Augiteporphyry of the Southern Tyrol." This is a detailed communication of some forty pages, which will doubtless be carefully studied by all interested in this particular subject.

The third part is devoted to a detailed account of the localities and horizons yielding useful minerals in the so-called Archaic and Devonian island of Westmähren, by Franz Kretschmer, mining engineer at Steinberg. This memoir of 142 pages deals very fully with the geological and physical conditions under which the graphite, lead, iron ores, &c., are found, and it is illustrated by a geologically coloured map, with sections and plans.

The fourth part of this volume is a memoir by A. Bettner on the Brachiopoda and Lamellibranchiata from the Trias of Bosnia, Dalmatia, and Venetia, occupying 149 pages, and illustrated by ten lithographic plates and seventeen zincographs in the text. The greater part of this work deals with fossils of Middle Trias or Muschelkalk age, derived from several localities, but perhaps a greater interest will be attached to the last twenty pages, dealing with the Upper Trias or Keuper forms from two localities in Bosnia. The whole memoir is a detailed description of species, and, as might be expected from their age and the little known localities from which they are derived, many of them prove to be new, but one cannot but be surprised to find that of some two hundred forms here described one hundred require new names. The plates accompanying this work are clearly drawn, but it is to be regretted that the figures are so crowded. All who have worked with such plates know how troublesome this is; one's eyes become dazed when trying to concentrate upon any particular figure. No doubt this memoir, like the one above noticed on the Werfen Cephalopoda, will become a classic in Triassic literature.

Part i. of vol. liii. contains several papers; the first of these, by R. Hoernes, on the ontogeny and phylogeny of

the Cephalopoda, deals with the initial chamber of the Nautiloidea, especially in the genus Orthoceras. Dr. Richard Johann Schubert and Dr. Lukas Waagen give an account of the Lower Silurian phyllopod genus Ribeiria, and establish a new genus, Ribeirella, for the species *R. Sharpei*, Barr. The remains of a male sheep's skull (*Ovis Mannhardi*) from the neighbourhood of Eggenburg are described by F. Toula, and carefully compared with recent and fossil forms; the paper is illustrated by a plate showing three views reproduced by photography and by three text figures. Dr. W. Hammer gives an account of the minute structure of porphyrite and diorite rocks from Ultenthal, giving six excellent photographic reproductions of microscopic sections. Dr. O. Able, in a memoir of some 50 pages, treats of the Tertiary marls and sandstones of the Tulln basin from both stratigraphical and physical standpoints, and comes to the conclusion that they begin with the Lower Oligocene and continue in unbroken series to the base of the Oncophora sands (Middle Miocene). Four sections across the valley are given to show the folding of the beds. Dr. Karl Alphons Penecke, in a paper of a dozen pages, describes a number of Upper Devonian corals obtained by Dr. Franz Scaffer from Hadschin, Antitaurus, during his journey in Asia Minor. Three new species are named. These corals are finely reproduced by photography on four double plates. In the last paper of this part Dr. W. Petrascheck describes some Inocerami from the Chalk of Bohemia and Saxony, giving the names *Ino. hercynieus* and *Ino. crassus* to two new species. This troublesome genus needs a thorough revision, and it is hoped that ere long someone will be found to undertake this useful piece of work, at least for the Cretaceous species.

ATMOSPHERIC ABSORPTION AND EMISSION OF THE EXTREME ULTRA-VIOLET RADIATIONS.

No. 1413 of the "Smithsonian Contributions to Knowledge" is devoted to a paper by Dr. Victor Schumann, of Leipzig, in which he minutely describes the apparatus used and the results obtained by him in spectroscopically determining the absorption and emission of air and its constituents for light of wave-lengths between 250 $\mu\mu$ and 100 $\mu\mu$. He obtained the photographic spectra of N, O, CO_2, CO, aqueous vapour and hydrogen by means of an ingeniously constructed spectroscope, from which he could exhaust all the gas except that on which he was experimenting, and this he introduced, in layers of definite thicknesses, after repeated purification. All the optical parts of the apparatus were made of white fluorspar, which is the most transparent substance, for these extreme ultra-violet rays, yet known.

Dr. Schumann found that nitrogen is very transparent even beyond 162 $\mu\mu$, but absorbs particular wave-lengths very energetically; the emission spectrum extends beyond 162 $\mu\mu$. Oxygen absorbs the radiations near to 185 $\mu\mu$ in a series of clearly resolved groups of lines, fourteen in number, complete absorption taking place beyond the most refrangible group of the series. This absorption is believed to be the cause of the atmosphere's opacity for radiations more refrangible than 185 $\mu\mu$. The absorption spectrum of CO_2 is similar in appearance to that of oxygen, but extends to much shorter wave-lengths; the persistent presence of bands due to carbon monoxide—which is one of the greatest difficulties Dr. Schumann has had to contend with in all his experiments, because their photographic action is exceedingly energetic and they extend far beyond 162 $\mu\mu$—has prevented the exact determination of the more refrangible limit of the CO_2 spectrum, which is exceedingly rich in lines. Carbon monoxide absorbs the more refrangible rays a little less than CO_2. The results of the experiments on the spectrum of aqueous vapour are rather uncertain owing to the formation of dew, but it chiefly consists of the hydrogen spectrum, the strong oxygen maximum at 185 $\mu\mu$, and a number of other lines the origin of which is at present unknown. The results, however, lead to the conclusion that a regular dissociation of the water vapour, accompanied by a simultaneous recombination, takes place. The results obtained with hydrogen are exceedingly interesting, and are discussed *in extenso* by Dr. Schumann. They show that hydrogen is intensely transparent, but the limit of transparency is not yet definitely determined. Twenty-fold enlargements of the hydrogen spectrum—having a total length of 1·4 metres—are reproduced in the paper, and show about 1500 lines between 185 $\mu\mu$ and 127 $\mu\mu$. Dr. Schumann states, however, that this latter value is rather uncertain, and is probably not the inferior limit of the true hydrogen spectrum as photographed by him. He also believes that between 185 $\mu\mu$ and 369·9 $\mu\mu$ the hydrogen spectrum is continuous.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

Mr. S. A. F. White, demonstrator in natural philosophy in King's College, London, since 1895, has been appointed professor of mathematics in succession to Prof. Hudson.

Dr. W. A. Osborne has been appointed to the professorship of physiology and histology in the University of Melbourne in succession to Dr. C. J. Martin, F.R.S., now director of the Lister Institute.

The Technical Education Board of the London County Council has arranged for two courses of free lectures for teachers to be given at the Horniman Museum, London Road, Forest Hill, S.E., on Saturday mornings from January 23 to May 26. Prof. Geddes will lecture on the natural history of plants, and a course of lectures on the natural history of man will be given by Prof. Alfred C. Haddon, F.R.S.

The annual meeting of the Association of Public School Science Masters will be held at Westminster School on Saturday, January 16, beginning at 1.45 p.m. Prof. W. A. Tilden, F.R.S., president of the Association, will be in the chair. Mr. R. E. Thwaites will read a paper on the possibility of fusing the mathematical and science teaching of public schools; and a discussion on science in the certificate examination will be opened by Mr. W. A. Shenstone, F.R.S., and Mr. M. D. Hill, who will deal with the chemical and biological parts of the examination respectively. Mr. O. H. Latter will read a paper on nature-study.

The eleventh annual general meeting of the Association of Technical Institutions will be held on Friday, January 29, at the Leathersellers' Hall, London, E.C., the president, Sir John Wolfe Barry, K.C.B., F.R.S., in the chair. Sir John E. Gorst, K.C., M.P., has consented to be nominated president of the association for the year 1904. Among other subjects to be brought before the meeting are:—Report as to the constitution of the advisory committee for the leather trades industries, in connection with the City and Guilds of London Institute, Prof. Wertheimer; the differences between the curricula and methods of staffing in British and American higher technical institutions, Dr. Walmsley; the consultative committee of the Board of Education and teachers' registration council, Principal Wells and Dr. Sumpner; and leaving certificates for secondary schools, Prof. Wertheimer and Principal Gannon.

An interesting essay by Dr. Walther Schoenichen on "The Evolution Theory in Schools" (Die Abstammungslehre im Unterrichte der Schule) has been published by the firm of Teubner (Leipzig and Berlin). The author shows that school instruction in botany and zoology has already passed through several phases—encyclopædic, systematic, analytic, and ethological—and maintains that the time has come for making it frankly evolutionary. This is necessary for scientific reasons and desirable for educational reasons, and, according to the author, it is also quite feasible. He argues that it will be useful ethically and will not endanger religion. The essay is wise and temperate, and many of the practical hints are very suggestive, *e.g.* the diagrams contrasting the multiplication of the hare and the elephant, the evolution of the kohl-rabi cabbage, and the origin of light-coloured from dark-coloured mice by selection.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, November 19, 1903.—"On the Physiological Action and Antidotes of Colubrine and Viperine Snake Venoms." By Dr. Leonard **Rogers.** Communicated by Dr. A. D. Waller, F.R.S.

The actions of various venoms have been studied by means of respiratory and circulatory tracings, &c. Firstly, the poisonous colubrine Indian snakes were dealt with. The *Loia bungarus* or hamadryad, the largest poisonous snake in India, was found to cause death by paralysing the respiratory centre, quickly followed by the motor end plates of the phrenic nerves, just as in the case of cobra. The *Bungarus coeruleus,* or common krait, also produced the same effect, only the end plate action was less marked. The *Bungarus fasciatus,* or banded krait, produced similar symptoms to the above in small doses, with the addition of marked circulatory failure, and in large doses also intravascular clotting like the vipers, and its venom was found to be a mixture of colubrine and viperine elements. The hæmolytic action of the above three venoms was much less marked than in the case of cobra venom, and has no lethal importance. The physiological action of the above and of the sea snakes having been found similar to that of cobra venom (with the exception of the added viperine element in the *Bungarus fasciatus*), Calmette antivenin was tested against them all, and found to be effective in varying degrees in each with the exception of the *Bungarus fasciatus*, in the case of which the colubrine element alone is neutralised, but the viperine one proves fatal. The serum is not, however, strong enough to be of the greatest value.

Secondly, the two true vipers, the *Daboia russellii* and the African puff adder, and two pit vipers, the *Crotalus horridus* and the *Trimenurus anamallensis*, were examined, and it was found that the one essential action common to all four was a paralysis of the central vasomotor centre producing a marked fall of blood pressure, followed sooner or later by secondary respiratory failure, but counteracted in a marked degree for a time by adrenal extract. In the case of the true vipers, large doses produce intravascular clotting, but by giving small preliminary doses, fatal vasomotor paralysis can readily be induced without any clotting whatever, while the venom of the rattlesnake readily produces the same effect without clotting in a single large dose, and also marked hæmorrhages, which are not caused by the Daboia.

December 3, 1903.—"On the Fructification of *Neuropteris heterophylla*, Brongniart." By Robert **Kidston,** F.R.S.

Royal Microscopical Society, December 16, 1903.—Dr. Hy. Woodward, F.R.S., president, in the chair.—Mr. F. W. Watson **Baker** exhibited under microscopes a series of slides, sixteen in number, illustrating the development of an ascidian from the fertilisation of the ovum to the larval stage.—Dr. G. J. **Hinde** read a paper on the structure and affinities of the genus Porosphæra.

MANCHESTER.

Literary and Philosophical Society, December 1, 1903.—Prof. W. Boyd Dawkins, president, in the chair.—The president directed the attention of the meeting to the fact that, although the rainfall during the last six months had been unusually heavy, the water in the deep springs had not increased proportionally, but was still below the average quantity for the last ten years.—Dr. W. E. **Hoyle** exhibited a model of the mole's nest, prepared by Mr. Lionel E. Adams, who read a paper on the subject before the Society some time ago. The model is in three parts, and shows the construction of a typical nest of the male mole very clearly.—Mr. F. F. **Laidlaw** read a paper entitled "Suggestions for a Revision of the Classification of the Polyclad Turbellaria," in which he considered more especially the acotylean genera, and based his classification of them on the characters of the prostate gland.

December 15, 1903.—Mr. Charles Bailey in the chair.—Prof. E. **Knecht** read a paper on an interesting reaction of copper salts. More than fifty years ago, Ebelmen had, in describing the properties of titanium trichloride, alluded to the property which this substance possesses of precipitating gold, silver, and mercury from their salts. The author showed that by using an excess of the trichloride, metallic copper could be precipitated from solutions of its salts, but pointed out that the reaction was a reversible one, and was consequently not complete. With titanous sulphate, however, the reaction with copper salts was complete, the copper appearing as an extremely fine metallic looking precipitate even in very dilute solutions (1 pt. in 1,000,000).—The electrolytic method for the detection and approximate estimation of minute quantities of arsenic in malt, beer, and food stuffs, by Mr. W. **Thomson.** An exhaustive series of tests has been made with the electrolytic apparatus devised by the committee appointed by the Commissioners of Inland Revenue in comparison with those obtained by the Marsh-Berzelius apparatus. From the results obtained the author lays stress on the importance of destroying the organic matter in beer, malt, &c., before introducing into the apparatus, and also puts forward the electrolytic method with zinc kathode as the most satisfactory for the estimation of minute quantities of arsenic.

DUBLIN.

Royal Irish Academy, Dec. 14, 1903.—Prof. R. Atkinson, president, in the chair.—Some new relations in the theory of screws, by Prof. C. J. **Joly.** Let A, B, C be any three points on the axes of any three screws, (1), (2) and (3) respectively, of a given three-system. Let B_1C_1 be the projection of BC on the axis of (1). Let (23) be the angle between the axes of the screws (2) and (3), and let sin (123) be the sine of the solid angle determined by the three axes. Then

$$\frac{B_1C_1 \cos (23) + C_2A_2 \cos (31) + A_3B_3 \cos (12)}{\sin (123)} + p_1 + p_2 + p_3 = a + b + c,$$

where p_1, p_2, p_3 are the pitches of the three screws, and a, b, c the pitches of the principal screws of the system. The author derived his results by the method of quaternion arrays, and showed that many relations similar to that given above may be deduced for screw-systems of any order.—Mr. John **Fraser** reduced the equation of a quartic surface possessing a nodal conic to the sum of squares of the five Jacobian quadrics of the systems of quadrics which pass through the conic, and which have double contact with the quartic surface. He gave explicitly the equations of the quadrics, and showed that the same method was applicable in the case of binodal quartic curves.

PARIS.

Academy of Sciences, January 4.—M. Mascart in the chair.—Researches on the emission of water vapour by plants and on their spontaneous desiccation: M. **Berthelot.** The roots and leaves of the plant investigated were first air-dried separately at the ordinary temperature, the temperature and hygrometric state varying during the experiment. After about eight days equilibrium was established, when the plants were further dried at 110°. A further loss of water was measured.—Proof of an experimental law given by M. Parenty on the flow of gases through orifices: J. **Boussinesq.**—The notion of work applied to the magnetisation of crystals: Pierre **Weiss.**—On osmosis: A. **Guillemin.** Adopting the theory of Halley, and the idea of the existence of a tension of expansibility, increasing with the depth below the free surface, the law of osmotic equilibrium takes the form that osmotic equilibrium exists when the tension of expansibility is the same on each side of the semi-permeable wall.—On the absolute value of the magnetic elements on January 1: Th. **Moureaux.** The absolute values and secular variation are given for the Observatory of Val-Joyeux, latitude 48° 49′ 16″ N., longitude 0° 19′ 23″ W.—On the stability of the direction of magnetisation in some volcanic rocks: Pierre **David.** It has been previously shown that some volcanic rocks possess a permanent magnetisation, which is probably that of the direction of the earth's field at the time when the rock solidified. This view has been confirmed by the examination of pieces of volcanic rocks taken from buildings dating from the Roman period. The inclination of all the pieces examined is identical, but the declination is variable.—On the decrease of temperature with height in the neighbourhood of Paris,

from five years' observations: Teisserenc **de Bort.** A summary of results obtained from experiments with captive balloons at heights varying from 500 to 14,000 metres.—Differential characters of the physiological radiations according as their origin is muscular or nervous: Augustin **Charpentier.** The rays emitted by muscle appear to be identical with the *n*-rays of Blondlot, but those emitted by nerves differ from these in that they are partially arrested by aluminium.—On the phosphoric esters of glycerin: P. **Carré.** The retrogradation and coagulation of starch: L. **Maquenne, A. Fernbach** and J. **Wolff.**—The use of sodium sulphide as an indicator in the estimation of glucose by Fehling's solution: L. **Beulaygue.** Very exact results can be obtained in sugar titrations by the use of spots of sodium sulphide on filter paper as an indicator.—The ablation of the parathyroids in birds: MM. **Doyon** and A. **Jouty.**—The selection of small differences which present the characters with continuous variations: Georges **Coutagne.**—On the double secreting apparatus of Dipteryx: Édouard **Heckel** and H. Jacob **de Cordemoy.**—On polymorphic transformations: M. **Wallerant.**—On the geology of the Alps: Émile **Haug.**—Contribution to the knowledge of the Lutecian formations of Senegal: Stanislas **Meunier.** The material collected by M. Friry confirms the view that there was a large Eocene sea in Africa, and also tends to show that there was direct marine communication between Senegal and Egypt.—On a substitute for ligatures in surgery: M. **Wassilieff.**

DIARY OF SOCIETIES.

THURSDAY, JANUARY 14.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—The City and South London Railway; Working Results of the Three Wire System applied to Traction, &c.: P. V. McMahon. (Adjourned discussion.)—On the Magnetic Dispersion in Induction Motors, and its Influence on the Design of these Machines: Dr. Hans Behn-Eschenburg.

ROYAL INSTITUTION, at 5.—The Flora of the Ocean: G. R. M. Murray, F.R.S.

MATHEMATICAL SOCIETY, at 5.30.—On Various Systems of Piling: Prof. J. D. Everett.—The Solution of Partial Differential Equations by Means of Definite Integrals:

$$\frac{\partial^2 V}{\partial x_1^2}+\frac{\partial^2 V}{\partial x_2^2}+\ldots+\frac{\partial^2 V}{\partial x_n^2}=0:$$

H. Bateman.—On the Notion of Lines of Curvature in the Theory of Surfaces: Dr. G. Prasad. On Groups of Order $p^\alpha q^\beta$: Prof. W. Burnside.—Electric Radiation from Conductors: H. M. Macdonald.—Open Sets of Points and the Theory of Content: Dr. W. H. Young.

SOCIETY OF ARTS, at 4.30.—The Presidency of Bombay: Sir William Lee-Warner, K.C.S.I.

FRIDAY, JANUARY 15.

ROYAL INSTITUTION, at 9.—Shadows: Lord Rayleigh.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—Sixth Report to the Alloys Research Committee on the Tempering of Steel: the late Sir William C. Roberts-Austen, K.C.B., F.R.S., and Prof. William Gowland.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Pumping and Disposal of Sewage at York: A. D. Creer.

PUBLIC SCHOOL SCIENCE MASTERS' ASSOCIATION, at 1.45.—The Possibility of Fusing the Mathematical and Science Teaching of Public Schools: R. E. Thwaites.—Science in the Certificate Examination: W. A. Shenstone, F.R.S., and M. D. Hill. Nature Study: O. H. Latter.

SATURDAY, JANUARY 16.

ROYAL INSTITUTION, at 3.—British Folk Song: J. A. F. Maitland.

TUESDAY, JANUARY 19.

ROYAL INSTITUTION, at 5.—The Development of Animals: Prof. L. C. Miall, F.R.S.

ROYAL STATISTICAL SOCIETY, at 5.

ZOOLOGICAL SOCIETY, at 8.30.—A Monograph of the Coleoptera of the Genus Hipporhinus: Guy A. K. Marshall.—On Proposed Additions to the Accepted Systematic Characters of Certain Mammals: Dr. Walter Kidd.—Some Observations on the Skull of the Giraffe: Dr. W. G. Ridewood.

SOCIETY OF ARTS, at 8.—Celtic Ornament: George Coffey.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Discussion of Paper on the Electrical Re-construction of the South London Tramways on the Conduit System: A. Millar.—To be followed by: The Sanding-up of Tidal Harbours: A. E. Carey.

WEDNESDAY, JANUARY 20.

ROYAL METEOROLOGICAL SOCIETY, at 7.30.—Presidential Address, The Present State of Ocean Meteorology: Captain D. Wilson-Barker.

ROYAL MICROSCOPICAL SOCIETY, at 8.—Presidential Address, On the Evolution of Vertebrate Animals in Time: Dr. H. Woodward.

GEOLOGICAL SOCIETY, at 8.—On the Jaws of Ptychodus from the Chalk: Dr. A. Smith Woodward, F.R.S.—On the Igneous Rocks of Spring Cove, near Weston-super-Mare: W. S. Boulton.

CHEMICAL SOCIETY, at 5.30.—Optically Active Asymmetric Nitrogen Compounds *d*- and *l*-phenylmethylethylbenzylammonium Salts: H. O. Jones.—The Chemical Reactions of Nickel Carbonyl, Part I., Reactions with the Halogens, &c.: J. Dewar and H. O. Jones.—The Chemical Reactions of Nickel Carbonyl, Part II., Reaction with Aromatic Hydrocarbons in Presence of Aluminium Chloride. Synthesis of Aldehydes and Anthracene Derivatives: J. Dewar and H. O. Jones.—A Microscopical Method of Determining Molecular Weights: G. Barger.—*o*-Nitrobenzoylacetic Acid: E. R. Needham and W. H. Perkin, jun.—The *cis*- and *trans*-Modifications of $\alpha\alpha\gamma$-Trimethylglutaconic Acid: W. H. Perkin, jun., and Miss A. E. Smith.—The Influence of Nuclear Substitution on the Rate of Oxidation of the Side-chain, I., Oxidation of the Mono- and Di-chlorotoluenes: J. B. Cohen and J. Miller. (1) A Simple Thermostat for Use in Connection with the Refractometric Examination of Oils and Fats. (2) The Interdependence of the Physical and Chemical Criteria in the Analysis of Butter-fat: T. E. Thorpe.—The Condensation of Furfuraldehyde with Sodium Succinate: A. W. Titherley and J. F. Spencer.

ENTOMOLOGICAL SOCIETY, at 8.—Annual Meeting.—The President, Prof. E. B. Poulton, F.R.S., will deliver an Address.

SOCIETY OF ARTS, at 8.—Organ Design: Thomas Casson.

THURSDAY, JANUARY 21.

ROYAL INSTITUTION, at 5.—The Flora of the Ocean: G. R. M. Murray, F.R.S.

LINNEAN SOCIETY, at 8.—An Account of a Plankton Expedition to the Bay of Biscay in H.M.S. *Research* in 1900: Dr. H. G. Fowler.—The Crustacea obtained by Dr. G. H. Fowler in the Biscayan Plankton: Rev. T. R. R. Stebbing, F.R.S.

FRIDAY, JANUARY 22.

ROYAL INSTITUTION, at 9.—Spectroscopic Studies of Astrophysical Problems at Stonyhurst College Observatory: Rev. Walter Sidgreaves, S.J.

PHYSICAL SOCIETY, at 5.—The Photographic Action of Radium Rays: S. Skinner.—Astigmatic Aberration: W. Bennett.—Some New Cases of Interference and Diffraction: Prof. R. W. Wood.—Exhibition of Instruments by Messrs. Crompton and Co.

SATURDAY, JANUARY 23.

ROYAL INSTITUTION, at 3.—British Folk Song: J. A. F. Maitland.

MATHEMATICAL ASSOCIATION, at 2.—Annual Meeting.—Models of Regular and Semi-regular Solids, including the four "polyèdres étoilés" of Poinsot, exhibited by Mr. E. M. Langley.—An Account of a Recent Discussion on the Possibility of Fusion of the Teaching of Mathematics and Science: C. S. Jackson.—A Geometrical Note: J. C. Palmer.—Advanced School Courses of Mathematics: C. A. Rumsey.

CONTENTS.

THURSDAY, JANUARY 21, 1904.

AN EVOLUTIONARY STUDY OF EUROPEAN POLITY.

The Development of European Polity. By Henry Sidgwick. Pp. xxvi + 454. (London: Macmillan and Co., Ltd.; New York: the Macmillan Company, 1903.) Price 10*s.* net.

HENRY SIDGWICK'S exposition of the theory of politics was published in two editions in his lifetime, as is well known to all English students of the subject. These posthumous lectures are the historical complement, "an evolutionary study of the development of polity within the historic period in Europe," as Mrs. Sidgwick says in her preface. The author conceived, as the final part of the work, a comparative study of living modern constitutions, founded so far as possible on personal observation. He did not live, unhappily, to carry out any substantial portion of that design. Everyone who knew Sidgwick or was acquainted with his work would expect his account of any period or aspect of European history to be sound and careful, notwithstanding that he was not a professed historian. Everyone who knows anything of the difference between finished and not quite finished work is aware of the difficulties that commonly attend the posthumous publication of an author's materials, even if he has not had the experience of being charged with such a production himself. General observations of this kind prepare the way, in many cases, for an appreciation more or less apologetic in tone.

On this occasion there is no question of apologies. We are not surprised that Mrs. Sidgwick's intimate knowledge and sympathy have given us a book in which not only there is no jarring contrast between the author's and the editor's hand, but the difference is barely discernible. We do confess to a little surprise at the comprehensive grasp of the matter, and the almost invariable sureness of judgment, disclosed in these lectures. Historical students who have no taste for philosophy (a mistaken frame of mind in our opinion, but common) may well be tempted to regret that Henry Sidgwick was not a historian altogether. We do not know of any book in English that covers the same ground as this; among those which intersect its lines it would be possible to find more wealth of learning and greater brilliance of style, but very hard to find so safe and impartial a guide.

As the topics dealt with range from the patriarchal family to modern cabinet government, and the treatment—even without the author's last hand—is by no means diffuse, it would be idle to attempt a summary. We may note, however, that the book is provided, as every book of its kind should be, with an excellent analytical table of contents as well as an index. In the earlier part there is a refreshing freedom from mere antiquarianism. Such a quietly humorous note as this on the Homeric banquets:—"Political dinners are very primitive institutions," is more effective than many solemn paragraphs to make the learner understand that even archaic history is concerned with real human nature.

The short chapter on the patriarchal theory partly follows and partly criticises Maine, and leads to the conclusion that

> "there is no reason to regard the father's power, in the patriarchal family, as the original type of political power; but doubtless the firm establishment of the patriarchal type of family contributed importantly to the stability and strength of tribal headship."

Indeed, Maine's own perfectly just view that the units of archaic society are not individuals but families requires us to ask, in the first instance, not how kingship, but how the primacy of one family or clan in the tribe is accounted for. Sidgwick's task was somewhat lightened here by the clear consciousness that he was trying to account only for European and not (for example) Mongol or Polynesian institutions. If Maine himself had more plainly disclaimed any intention of dogmatising on anthropology at large, some not very profitable controversy might have been spared.

A word of special criticism on Maine occurs in a later chapter:—

> "I cannot agree with Maine that codes [in early Greek and Roman history] generally included no new law."

This, no doubt, is sound in itself, but we cannot find that Maine really committed himself to any such statement, though he dwells mainly on the consolidating function of ancient codes. Farther on we have a more substantial amendment. Sidgwick declines to conceive the Roman *jus gentium* as formed by a process of deliberate selection from the customs of different Italian (or Mediterranean) communities.

> "It is clear," he says, "that the development of the kind of law afterwards known as *jus gentium* was entirely due to practical needs; and we may connect it with the development of Roman trade."

It is right to point out that Maine himself, in his later work, did suggest a connection with market law. The present writer is disposed to go farther, and to regard the incipient *jus gentium* as having been, in fact, the custom of merchants. Without some general customs trade could not have gone on at all, and if they existed it was an obvious course for the Roman jurisdiction to adopt them. Sidgwick rightly notes in the same chapter the theoretical divergence between *jus naturae* and *jus gentium* on the point of slavery.

The mediæval section is remarkably good, although Henry Sidgwick's particular tastes and studies did not lie that way. Mediævalists, as well as ordinary historical students, will find profitable matter in the treatment of Italian and German autonomy with regard to the general political development of Europe. The contrast between Continental feudalism, leading first to wild particularism and then to a reaction towards absolute monarchy, and the stronger central government which saved England from despotism, by an apparently despotic but really popular system, is not in itself new, but is thoroughly well brought out.

England, nevertheless, had a narrow escape; we have been slow to realise how narrow it was. Mr. Maitland was the first, we believe, in his Rede lecture two years ago, to claim boldly for the common law and its traditions their due share in effectual resistance at the critical time. This point, though lightly touched on by Sidgwick, did not escape him; see his well weighed remarks on the unity of the common law and of Parliament (p. 312). The beginning of modern political history and constitutional doctrine is placed at the peace of Westphalia, and we do not think a better date could be found. We have some doubt on a matter of detail in the next stage. Blackstone is the normal representative of the doctrine accepted in the reign of George III. Sidgwick acquiesces in the current view of Montesquieu's influence on him, but we think that Blackstone's own practical consideration of Locke may have counted for more than is commonly supposed, and Montesquieu, whose work was still very recent when Blackstone wrote, for less. Although Blackstone was not, on the whole, an original thinker, there is no reason to assume that he never did any thinking for himself.

The reader is finally conducted with a sure hand through the modern development of constitutional and cabinet government to the prospect of federalism as the most important factor in the coming generation.

FREDERICK POLLOCK.

A CONTRIBUTION TO CALIFORNIAN GEOLOGY.

The Palaeontology and Stratigraphy of the Marine Pliocene and Pleistocene of San Pedro, California. By Ralph Arnold. Pp. 420; 37 plates. (California: Stanford University, 1903.)

THIS, the latest of the well-known "Contributions to Biology from the Hopkins Seaside Laboratory of the Leland Stanford Junior University" (reprinted from the *Memoirs* of the California Academy of Sciences, vol. iii.), forms a dissertation presented to the faculty in geology of the university for the degree of doctor of philosophy, and is by far the bulkiest of the thirty-one "Contributions" as yet published.

It may not, perhaps, contain matter apparently offering such brilliant results as some of its predecessors, but it yields to none of them in being a most sound and important contribution to the knowledge of a scarcely touched subject. Nor is it the outcome of some spasmodic effort of the moment, for Mr. Arnold began the work in the winter of 1886, and has paid several visits each year since to the fossil-bearing beds of San Pedro.

In the field work and in collecting the author had the assistance of his father and the further cooperation of numerous friends, principally of Dr. J. P. Smith, Dr. J. C. Branner, and, in the systematic work, of Mr. Wayland Vaughan and Dr. Dall.

The deposits investigated rest on raised and contorted Miocene shales, while a similar unconformity is evident between the Pliocenes and Pleistocenes themselves. All are successively overlain by alluvial soil with Kitchen-middens. In thickness these beds exceed any of the same age in this country, and attain in the Pleistocene to more than 1300 feet, and in the Pliocene to about 5000 feet.

In the first portion of the work the information concerning the various subdivisions is summarised, and lists of the several fossil contents are given. The faunal relations of the beds are of great interest. The fauna of the Pliocene strata is similar to that now living only a short distance off-shore from San Pedro, but probably in colder water than is found in-shore; it also contains 18·5 per cent. of species only found living further north, hence the climate was probably colder on the coast of California at the time of deposition than it is at the present day.

In the succeeding Pleistocene deposits the lower series reveal by their fossil-contents a change in climatic conditions towards tropical, while in the upper series semi-tropical conditions appear to have prevailed.

Great similarity is shown to exist between the later Tertiary and Pleistocene marine invertebrate fauna of Japan and that of the western coast of the United States, though the living faunas are not as closely related.

The second portion, or the "description of species," forms the bulk of the work, and occupies 276 pages, of which all but 12 deal with the Mollusca. The excessive preponderance of molluscan remains, indeed, is one of the most remarkable features connected with these beds. The diagnoses of the few new Anthozoa are by Mr. Wayland Vaughan, whilst to Dr. Dall the author acknowledges indebtedness in the identification of some of the Mollusca and for superintending the text relating to the Pyramidellidæ, which was prepared by Mr. Paul Bartsch.

In his classifications the author has wisely followed well-known text-books or memoirs, and though this course necessarily results in the nomenclature being in some places not quite of the latest description, it enables the work to be more readily followed than if some fresh arrangement had been adopted. One rectification we are glad to note in Mr. Bartsch's portion—Fleming's name, *Odostomia*, resumes its pride of place.

A useful bibliography forms the third part of the volume, albeit unduly extended to include works that might have been, rather than that were, actually referred to, and even to embrace all the papers of one writer because he was considerate enough to supply them, although a considerable number have no bearing whatever on the question. That the G. B. Sowerbys should have become mixed is not surprising, but "Sowerby, James, and De Carls, James" should have been avoided.

The thirty-seven plates, twenty-one of which relate to the fossils, are of that high quality which we have come naturally to expect in works of this class produced in the United States, and he who could find aught to cavil at in them must indeed be hard to please.

B. B. W.

PHYSIOLOGY AND ALCOHOL.

Elementary Physiology and Hygiene. By Prof. Buel P. Colton, M.A. Heath's Modern Science Series. Pp. viii+317. (London: D. C. Heath and Co.) Price 2*s.* 6*d.*

THIS book has obviously been written to supply the wants of the American schoolchild, and consequently

"the subject of *alcohol* has been treated very thoroughly and in full compliance with the laws of the various States."

"Throughout the book the effects of alcohol and other narcotics have been discussed in close connection with the accounts of the functions of the body."

"A number of authoritative quotations have been made, so that the pupil may know that the statements made are supported by the most eminent authorities of the world on these subjects."

The above quotations from the author's preface show that it has been a pleasure to him to comply in his book with the law enjoining that all text-books of physiology used in American State schools must contain a description of the effects of alcohol upon the body.

So thoroughly has this instruction been carried out that it appears on reading the book as if in many cases the very brief descriptions of the physiology of the different tissues had been written chiefly as introductions in order to make clear the dire effects of alcohol, which are subsequently described in each case.

There is a denunciation of alcohol in every chapter, and its ill effects upon every tissue in the body, from the bones to the brain, through the whole gamut of the muscles, blood, circulation, respiration, digestion and excretion, are specially described in words usually chosen from well-known authors; and then, as if feeling that this alone were not sufficient, the author adds a chapter, written in great part by himself, dealing entirely with alcohol and its disastrous effects upon the body.

Truly this book must be appalling reading to the American schoolchild whose parents may be in the habit of making even moderate use of alcoholic drinks, until time has eventually brought the convincing comfort that the parents do not suffer so badly as might have been expected from the descriptions of the text-book.

It is a pity that the picture is so overdrawn, both for the sake of the effect upon the mind of the child and the valuable reformation of the parent which might have been effected through the child.

It is most desirable that every adult in every country should know the evil results upon the system of over-indulgence in such a powerful drug as alcohol, but it is highly questionable whether any good result can follow the drawing of such lurid pictures as are found here for the perusal of boys and girls at school.

The style of the book is not beautified by the use of the English instead of the Latin plural, so producing such monstrosities as *pleuras, ganglions, ciliums, villuses,* and *papillas.* The author states that this has been done to avoid puzzling the student who has not "had Latin," appearing to forget that such words have become part of the language, and that it is a drastic procedure to coin many new and uncouth words to save his readers the labour of acquiring a knowledge of the Latin plural forms. This knowledge they ought already to possess at school before they have reached the stage of studying physiology and hygiene, unless school work is becoming very inverted and chaotic.

In addition to inventing new plurals, the author in his preface admits the manufacture of new words, again on the plea of simplicity, and further examples of this practice are to be found in the text, such as *aur-vent* and *vent-art* valves on p. 52.

The book contains a smattering of popular physiology and a very small amount of elementary hygiene, but it appears to the reviewer to be a volume which ought specially to attract temperance lecturers in search of "material" for their discourses.

Benjamin Moore.

A BOOK OF ENGLISH SPORTS.

English Sport. Edited by A. E. T. Watson. Pp. ix+361; illustrated. (London: Macmillan and Co., Ltd., 1903.) Price 12*s.* 6*d.* net.

IN this handsome volume, illustrated by a large number of exquisite coloured plates (many of which are photographs), the editor has managed to compress into a comparatively small size an interesting and accurate account of all the chief English sports. All the articles, each of which is written by a recognised authority on his special subject, have previously appeared in the *Badminton Magazine,* but since the series was compiled with a view to subsequent republication in book form, there is not that lack of connection and completeness—to say nothing of overlapping—which is sometimes noticeable in collections of this nature. To particularise the names of the different contributors would be unnecessary on the present occasion, but a glance at the table of contents will be sufficient to convince the reader that the editor has been especially fortunate in obtaining the cooperation of such a number of names well known in the sporting world.

To review in detail a work of this nature comes more within the province of journals devoted specially to field and other sports, and we shall therefore, while commending the volume to the best attention of those whom it more immediately concerns, content ourselves with a few brief references to points more or less intimately connected with natural history.

All lovers of British animals cannot fail to find much matter of interest in the article by Viscount Ebrington on hunting the wild red deer in Devon and Somerset, of which his lordship, in his capacity as master of the hunt, probably knows more than any man living. Those who read this article must be convinced what an excellent lesson in "nature teaching" is afforded by the cultivation of the power of minute observation essential on the part of all those concerned in discovering the whereabouts of the quarry. In the article on harriers ancient and modern by the late Earl of

Suffolk and Berkshire, reference is made to the now almost forgotten fact that no later than the first half of the last century many of these hounds—and we presume fox-hounds also—were whole-coloured, instead of being of the tripartite "hound-colour" with which we are now familiar. Reddish was the prevalent tint, with a tinge of brownish-grey along the back, so that the hound was very similar in colour to the hare of which it was in pursuit. This, of course, has an important bearing on the ancestral stock from which our modern hounds are derived, and tends to confirm the view of Bell as to the derivation of these animals from a bloodhound stock.

As the editor admits in his preface, some objection might legitimately be raised to the inclusion in the volume of an article by Lord Delamere on lion-shooting in East Africa, and of another by Lord Walsingham on Spanish ibex hunting, since if these are admitted it is somewhat difficult to see why big game shooting in general was not included. Taking, however, the facts as they are, we find some very interesting points in Lord Delamere's narrative—notably the statement that wart-hogs, when chased by lions to the deserted aard-vark holes, in which they often take up their abode, invariably enter backwards, so as to present their formidable tusks to an assailant. In the course of his account of a hunting trip to the haunts of the Spanish ibex, or wild goat, Lord Walsingham records many interesting points in connection with the fauna and flora of the districts traversed.

With this we take leave of an attractive volume which ought to occupy a handy position in the library of every British sportsman. R. L.

OUR BOOK SHELF.

Theoretical Mechanics. An Elementary Text-book. Second edition. By L. M. Hoskins. Pp. xi+456. (Published by the author, Stanford University, Cal., 1903.) Price 3 dollars.

WE have here a very clear and lucid exposition of the fundamental principles of mechanics, presented always with incisive logic, in a simple manner, and enforced and illustrated at frequent intervals by well selected examples.

The book is divided into three parts, of which the first deals with statics, and includes a chapter on gravitation and the attraction of spherical shells. The second part is concerned with the dynamics of a particle, and part iii. treats of the motions of systems of material particles and of rigid bodies.

The subject is treated mainly by analytical methods, an elementary knowledge of the calculus being assumed. But the vector nature of the subject is always kept prominently to the fore, and the vector significance of the various terms in the dynamical equations is brought well home to the student by ample illustrations and descriptions. The book opens with a special chapter on vectors, and vector equations are freely employed throughout, verging sometimes on the use of vector products, as, for instance, when establishing the relations which exist amongst the various quantities in the case of the transformation of axes in the instructive chapter on relative motion which concludes the volume, and which has been added since the first edition.

Attention is mainly confined to motion of translation in space, and to the general case of plane motion, general motion in three dimensions being only casually alluded to. This seems to us a wise arrangement, as, in the space available, it allows the treatment to be very full and complete.

The C.G.S., the poundal-pound, and the "engineers'" systems of units are all clearly explained. The author, however, seems to be under some misapprehension as to the unit of force in the engineers' system. He says this varies with the locality on account of the variation of gravitation, but that the system could be made dynamical by specifying the locality. In this country, at any rate, such specification is made, and the engineers' system is thus as strictly absolute as the C.G.S. or the poundal-pound systems.

Considering the importance of harmonic motion in its many applications, as in electricity, in problems on balancing, in harmonic analysis, &c., many readers would have welcomed a special chapter devoted to the subject, including some reference to rotating vectors.

In a treatise like the present, it would seem highly desirable that a short account of the experimental verification of fundamental laws should be given, and the student be directed to carry out the experiments personally in the laboratory. But there is little room for adverse criticism in this most excellent text-book, which is one of the best on the subject that has recently appeared, and cannot fail to give satisfaction wherever used.

Atlas des Erdmagnetismus für die Epochen 1600, 1700, 1780, 1842 *and* 1915. By Dr. H. Fritsche, Director emeritus des K.R. Observatoriums in Peking. (Riga: Müllerschen Buchdruckerei, 1903.)

THIS work consists of a series of charts of equal lines of magnetic declination, inclination, and horizontal force for the five epochs 1600, 1700, 1780, 1842 and 1915, calculated by the author with the assistance of the Gaussian theory.

In his introduction he discredits the accuracy of the charts of the epochs hitherto published by Hansteen, van Bemmelen, Sabine and others as being the results of observation only, many of such observations being defective, and the lines drawn without the help of any theoretical groundwork. There is a mistake here as regards Sabine's charts of the Arctic and Antarctic regions, as the Gaussian lines calculated for 1840 were largely used in their construction. Nevertheless, the author has spared no pains in his endeavour to replace what he condemns by something better, hence the present charts.

Considering the existing knowledge of terrestrial magnetism as regards the secular change of the magnetic elements, and our limited knowledge from observation of the conditions in the southern parts of the earth, the author appears to be somewhat premature in providing charts of inclination and force for the epochs 1600 and 1700, especially when so little was known of either element before the early years of the last century.

From the lengthened period during which the declination has been observed, the means exist for comparing the theoretical results of these calculated charts with good normal observations. Thus at Cape Town we find for the epochs 1842 and 1915 a difference in declination of $-1^{\circ}.5$ and $+2^{\circ}$ respectively, and at other well-known places similar differences.

Again, these charts indicate that the north magnetic pole moved in a south-easterly direction nearly 700 miles in the 315 years since 1600, some 93 miles of these being traversed between 1842 and 1915, whereas observations during the latter period indicate that the pole moved in a north-westerly direction. The south

magnetic pole is declared to have moved about 800 miles in a north-westerly direction between 1600 and 1780, then about 400 miles in a south-easterly direction between 1780 and 1915.

The remarkable results thus given in these charts can hardly be accepted until observation has done its work and provided a better basis of calculation than that at the disposal of their author.

The Wonderful Works of God. Pages from the Book of Nature. By J. Polkinghorn. Pp. iv+156; illustrated. (London: Society for Promoting Christian Knowledge, 1903.) Price 2s.

THE purport of the book, it is said, is to awaken an interest in the marvels of creation, and perhaps this might have been done without the introduction of quite so many "pious reflections." Be this as it may, the author might at least have taken care that all his statements were up to date, and at the same time have avoided the introduction of misleading illustrations. As an example of the former failing, we may refer to the statements (p. 29) that sponges are included in the Cœlenterata, and (p. 94) that a few birds probably hibernate (*vide* A. Newton, "Dictionary of Birds," p. 928). As regards the second point, we may direct attention to the figure on p. 29, in which the shell borne by a soldier-crab presents no resemblance to that of any mollusc with which we are acquainted. Although exception may be taken to the mode of treatment, the purport of the book is deserving of all commendation.

Riviera Nature Notes. Second edition. Pp. xv+402. (London: Bernard Quaritch, 1903.)

THIS volume will be a welcome addition to the library of everyone who is interested in the old-fashioned hobby of field natural history or its modern substitute of "nature-study." The first edition, which was published in 1898, was a delightful book, but it left much to be desired in the matter of paper, printing, illustrations, correction of misprints, and similar matters of general detail. In all these respects the present volume is quite a different book from its predecessor, and though a few misprints still survive, it is evident that no pains have been spared in producing a well printed book, the illustrations in which are quite works of art. The anonymous author states that he is a schoolmaster by profession, and that the book was written as a recreation, and with no intent to produce a scientific treatise. But those who have visited the shores of the Mediterranean will know that the fauna, the flora, and the folklore of this region possess an individuality of which no adequate impression can be conveyed by exact scientific descriptions, but of which a much better idea can be obtained from the descriptions and illustrations given by one who is evidently familiar with every nook and corner of the district. We cordially agree with the last words of the preface:—"But I may, perhaps, venture to plead that there are many recreations even less profitable than writing notes upon the Natural History of the Riviera."

The Square Circled. By P. O. P. Pp. 44. (Edinburgh: E. and S. Livingstone, 1903.)

MANY writers have given approximate geometrical constructions for straight lines equal in length to arcs of circles, and some of these are so simple that it seems a pity they are so rarely seen in text-books. This remark in no way applies to the constructions given in the present book. Most of the figures are very involved and complicated, containing between thirty and forty lines. If the methods really did lead to an exact and not merely an approximate construction for squaring the circle, the use of ruler and compasses would introduce errors far greater than those which would arise from taking even such a rough value for π as $3\frac{1}{7}$. It is a pity that the author before writing this book did not consult a mathematical friend. Had he done so he would have been told that his "V-shaped curve" is a portion of a cycloid, and he would not have issued the book in its present form.

The Garden Diary and Calendar of Nature. With Gardening Directions by Rose Kingsley and Preface by G. A. B. Dewar. Pp. x+Diary. (London: George Allen, 1904.)

A FEW nature and other notes, together with directions as to the month's work in the garden, precede the diary for each month. Every day throughout the year is provided with an appropriate poetical quotation and a space in which to record personal observations of nature in the garden and elsewhere. Altogether a pleasing compilation.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

Oxford Science.

To the report of a lecture recently delivered in Oxford (NATURE, vol. lxix. p. 207) Prof. Perry appends a footnote in which he states that if he were to endow a professorship in some definite branch of science at Oxford, the authorities would appoint a man who never had done, and who never could be expected to do, any research work, and whose highest ambition would be to act zealously as the bursar of his college! As some of the readers of this report might regard this statement as being literally true, it is as well it should be contradicted. Of the fourteen full science professors at Oxford, only one is, or ever has been, a college bursar. In fact, nearly all the professors are eminent men, who by their research work have contributed in no small measure to the advancement of science. All are fellows of the Royal Society, and nearly all have served on its council.

Prof. Perry's statement that Oxford turns out very little research work of any kind is likewise unsupported by facts. As can be seen from the "Reports of University Institutions" (published by the Clarendon Press), the amount of research work done in Oxford is increasing every year. To take but a few instances, we find that, in 1902, workers in the department of physiology published eighteen original memoirs, those in the department of astronomy eleven, and those in the department of comparative anatomy ten memoirs, whilst from the Hope department of zoology two bulky volumes of collected researches have been published within the last few months. In fact, I challenge Prof. Perry to name a single professor, lecturer or demonstrator, in the departments of physiology, comparative anatomy, zoology, geology, botany, physics (electricity), astronomy or mineralogy, who is not engaged upon research at the present time, and who has not published original work during the last year or two. Again, many of the colleges are subsidising research by electing research fellows rather than fellows by examination. Of such fellows—all elected within the last few years—it will suffice to mention the names of Messrs. Arthur Evans and D. G. Hogarth, whose exploration work in Crete is known to all, and Messrs. Grenfell and Hunt, equally well known for their work in Egypt.

The statement that Oxford hates science does not seem to be borne out by the fact that, of the total yearly revenue of the university (as apart from the colleges), more than 10,000*l.*, or a seventh part of the whole, is devoted to the upkeep of the science departments and the payment of science readers and lecturers. Many of the colleges are no less liberal in their support of science and research. To

take a single instance, Magdalen College spends more than 5000*l.* a year upon science professorships, fellowships and scholarships, or a seventh part of its net revenue, and of the last twelve fellowships it has awarded, six have been for research. Also it keeps up a very efficient private laboratory, as, indeed, do five other colleges in the university.

Oxford, January 9. H. M. VERNON.

I THINK that others may interpret the footnote as Mr. Vernon does, and it is therefore my intention to express myself more clearly when the address is republished. Surely all Oxford science men know what I meant to say, and if so, they must know how difficult it is to say it without making two or three particular references. It is evident from other parts of my address that I certainly did not mean that most of the Oxford science professors neglect research. On the contrary, I know that the majority of them perform their duties well, including duties as to research, and they do this in an antipathetic atmosphere such as science professors elsewhere know nothing of. If I had the inclination to punish a scientific man and the power, I would appoint him to an Oxford science professorship.

Some of the most distinguished workers were listening to my address, and I know that they were not much annoyed when I expressed my opinion that, relatively to the position and wealth of Oxford, there is very little being done. We know the names of the Oxford men who are doing good research work in Oxford and elsewhere, and surely Mr. Vernon will not say that they form one-tenth of one per cent. of the number of living men who have been educated at Oxford. But I am not concerned with the easy standard which he is satisfied to apply. I was expressing what is a very general opinion, and one that is certainly my own. Also in saying that Oxford fears and hates natural science I was expressing a very general opinion. It is ridiculed by Mr Vernon, but he does not disprove it when he tells how Oxford trifles with science by the establishment of what are called science scholarships and fellowships and starved little laboratories.

Public opinion has been burked for many years by this grotesque fooling. Add to this that the majority of the dons throw ridicule upon natural science studies and create an atmosphere in which it is nearly as difficult for a man to do scientific work as it is for a mouse to live in an atmosphere of carbonic acid. An earnest student of natural science swims in a sea of troubles, and the university authorities in their love for him ornament him with a millstone of compulsory Greek as neck ornament. Surely this is something worse than trifling; it is torture. The torture is not so exquisite as what is applied to natural science in schools which are under Oxford influence, but it serves its purpose. JOHN PERRY.

An Undescribed Rudimentary Gill-plume in the Cray-fish.

I SHOULD be glad if you would allow me to place on record the discovery, by Miss Margery Moseley (daughter of my old friend, the late Prof. H. N. Moseley, of Oxford), in specimens of the common cray-fish (*Astacus fluviatilis*), of a pair of minute gill-plumes (right and left), belonging apparently to the somite of the first pair of maxillipedes. Miss Moseley discovered these new minute gill-plumes, independently, in the course of dissection of a series of "types" in the department of comparative anatomy at Oxford. Finding no description of them in the text-books, and that they were not recognised or admitted by the authorities, she sent her notes and drawings on the subject to me. The discovery has been confirmed at my request by Dr. Calman, who is engaged in work on the Crustacea at the Natural History Museum, and he expresses his astonishment (in a letter to me) that so important and (when once noted) so obvious an organ can have been overlooked by the many students who have carefully examined the cray-fish since Huxley made it one of his "types," and published his researches on the gills of the astacoid Crustacea.

The discovery is interesting, not only as a fact in the morphology of Crustacea, but as being a novelty in a subject treated with special attention by so skilled an observer as Huxley, and minutely examined by thousands of students and teachers during the last twenty years. Miss Moseley is preparing a description and drawings of the new gill-plumes for immediate publication.

January 15. E. RAY LANKESTER.

A Theory of the Cause of Atmospheric Electricity.

THE idea that the sun sends out a large amount of Becquerel rays has found considerable support in the scientific world, and has been used to explain a number of difficulties connected with cosmical physics, for example, the source of the sun's energy and comets' tails. There is still another old standing difficulty which it appears to be able to solve, viz. the permanent maintenance of the electrical field in the lower regions of the earth's atmosphere. If we take for granted that the sun continually emits Becquerel rays consisting of positive and negative electrons, one would expect the following to be the consequence. Some of the electrons which reach the earth's atmosphere will be absorbed—probably mainly by the water vapour and dust in the lower atmosphere—but according to Rutherford's experiments more positive than negative; thus we may expect a greater number of negative electrons to reach the surface, a corresponding number of positive electrons being held back by the air. We at once see a cause for the positive charge of the air and the corresponding negative charge on the surface. If there were no "dissipation" the result would be a continual charging up of the atmosphere or an ever increasing potential gradient above the earth's surface; but there is dissipation, and it counterbalances the tendency of the electrical field to increase. If we had a constant dissipation the result would be a maximum potential gradient in the daytime and a minimum in the night, for we must assume that more electrons reach the atmosphere in the day than in the night. But we know from Elster and Geitel's measurements that the dissipation reaches a maximum at midday; this will tend to reduce the maximum of potential gradient which would otherwise be reached about that time. This consideration agrees entirely with the fact, for Exner has described the daily variation of the potential gradient as "a simple daily period, distorted by a midday depression." With the fairly constant daily period of the entrance of electrons into the atmosphere, the main determining factor of the potential gradient will be the dissipation; thus we find a maximum potential gradient in the winter with a corresponding minimum dissipation. The relation between potential gradient and dissipation has been thoroughly investigated by Elster and Geitel, and they have found experimentally that "that which tends to reduce the dissipation tends to increase the potential gradient," which is just what one would expect from the theory. This theory appears to me to be able to account for a great many more of the problems of atmospheric electricity, but the above will show the general idea. GEORGE SIMPSON.

Projection of Imitation Spinthariscope Appearance.

WITH reference to Sir Oliver Lodge's letter in NATURE of last week (p. 247), might I venture to say that I exhibited to a large audience the nature of the effect seen in a spinthariscope in a lecture which I gave on radio-activity at the Cavendish Laboratory last term? My plan is somewhat similar to that suggested by one of Sir Oliver Lodge's sons, and consists of two black discs rotating in opposite directions in a mechanical slide. The discs have a large number of transparent spots, so that whenever two of these coincide a flash is produced on the screen. The resultant effect is the same as that seen in the spinthariscope. The coincidences can be arranged so as to be most numerous near the centre. J. B. B.

The Diminishing Size of the New Bishop's Ring around the Sun.

IN addition to the notes recently given in NATURE by Prof. Forel, Mr. Rotch and Mr. Backhouse concerning the new Bishop's Ring, I should like to direct attention to the steadily diminishing size of this ring.

Mr. Backhouse says in vol. lxvii. (p. 174) that the middle of this reddish ring in the summer of 1902 was 70° from the sun, but on December 21 it was only 40° from the sun.

The first measurements made by me were on January 9, 1903, when I found the faint reddish ring extending from between 25° and 30° to about 40° from the sun, the mean distance being about 33°. On January 20 several measurements made with an altazimuth instrument gave the mean distance of the middle of the red ring as 30° (see *Science*, N.S., vol. xvii. p. 150, January 23, 1903). On February 24, measured by an altazimuth instrument, the reddish glow extended from 26° to 31° from the sun, the mean being about 29°. On May 13 the average distance of the middle of the ring was by measurement roughly about 30°. On June 26 it was found to be about 26° from the sun. All these measurements were made at Blue Hill between 10 a.m. and 2 p.m., and the distance was measured from the sun vertically upward to the ring.

On September 1 Mr. Rotch, when on the summit of Mont Blanc, measured the distance of the ring from the sun, and found it to be between 20° and 25°, which would give a mean distance of about 23° (NATURE, vol. lxviii. p. 623).

On October 14 I again measured it at Blue Hill with a sextant, and found it extended out to 26°, which would give a mean distance of about 23°. A recent measurement by me on December 28 with an altazimuth instrument showed that it extended from about 16° to 24° from the sun, giving a mean distance of 20°.

Putting these measurements together, the following results are obtained:—

1902 Aug.	Dec.	1903 Jan.	Feb.	May	June	Sept.	Oct.	Dec.
70°	40°	32°	29°	30°	26°	23°	23°	20°

These results show a very rapid decrease in size at first, followed by a diminishing rate of decrease.

When I began my measurements I had not seen the letter of Mr. Backhouse, and did not see it until about a month ago. I anticipated that the ring would grow larger with time, reasoning that if the ring was a diffraction phenomenon, due to volcanic dust, the larger particles of dust would fall first to earth, leaving the smaller particles, and theoretically this ought to increase the size of the ring. I have been surprised to see the ring grow smaller. Perhaps it is because the whole of the particles causing it are getting nearer to the ground. Inside the very faint reddish ring described above, is a whitish glare which is visible to everyone, but I find that many people are unable to distinguish the reddish ring, which is very faint, and only distinguishable by anyone on the clearest days, and is most distinct when the sun itself is hidden by a cloud.

HENRY HELM CLAYTON.

Hyde Park, Mass., December 30, 1903.

Subjective Images.

WILL you kindly allow me to submit the following case for the consideration of your readers? I was reading a book one day in the open air, and the full light of a strong sun was shining on the printed page. After reading for about half an hour, I went over to a fountain, a few yards distant, in the shade of some trees. On a white marble slab attached to the fountain, there was an inscription, which I knew to be in jet black letters. To my surprise, the letters now appeared to my eye a rich emerald green. So brilliant and persistent was this green that I thought, for a time, that the colour had been really changed. After a few minutes, however, the green hue slowly faded away, and the letters appeared black as before.

The explanation that occurs to me for the moment is that the impression made on the retina by the different colours present in white light, lasts longer for some colours than for others, and that it lasts longest for the green. Thus the retina having been exposed for a considerable time to an intense white light, retained the impression of green after the impressions made by the other colours had faded away, and accordingly those portions of the retina on which the image of the black letters fell would still produce the sensation of green, while that sensation would be practically effaced for the remainder of the retina by the strong white light of the marble slab. It would be interesting, I think, if any of your readers could give evidence of a similar experience, or offer any better explanation of the phenomenon.

GERALD MOLLOY.

86 Stephen's Green, Dublin.

National Science Scholarships.

As a former student of the Royal College of Science and School of Mines, London, S.W., I was much struck by the hard working, studious demeanour of the national scholars I came into contact with at this excellent institution, and it seems to me that they are deserving of a better fate than being compelled to exist in London and to find many college necessaries out of 25*s*. per week, which I understand is only paid them during term time (p. 237). I am proud to be able to number several of these fine fellows among my intimate friends, whose mental calibre makes their companionship an acquisition; the miserable pittance doled out would seem hardly likely to attract such material, and seems to me only calculated, in many cases, to crush the element it professes to foster, and to turn out drudges for the general use and convenience of others possessing healthier digestions and a more extended knowledge of the world in general.

In this age of educational raving, when, apparently, it is assumed that the expenditure of large sums of money on the erection of colossal buildings is the surest way of building colossal minds, it makes one hesitate and wonder what education of any kind means.

Surely the object of scholarships should be two-fold, or more than two-fold, to make *men*, as well as *men of science*, and to educate in accuracy and truthfulness, and manliness also, and not to make mental and physical wrecks by ignoring earthly needs, yet the latter must result in many cases from such false economy. Either the scholarships should be made sound in every way or they should be abolished; the country would at any rate gain by a reasonable number of healthy minded citizens, which no nation can afford to despise in the race of life as it goes on to-day.

I think your suggestion of suitable halls and corporate life a good one; it is a need of the Royal College of Science, it is in fact, a need of all large colleges and universities drawing students from the various quarters of the Empire. The system of halls for a college should, in my opinion, be in miniature representative of the colleges of Cambridge and Oxford, a system which has probably assisted in maintaining the pre-eminence of these universities more than one is at first sight prepared to admit. Each unit belonging to the mother institution striving to obtain good men and fostering them by every encouragement to work for the hall they represent, let each hall have its cherished list of names of prizemen, and thus convert what, in a simple college not possessing such units, becomes a system of pacemaking into a healthy, manly, and sportsmanlike competition, in which the honour of the hall is at stake equally with that of the individual, where each will do his best work and be free from that tendency on the part of many high minded individuals to condemn themselves for entering into direct competition with less healthy, less capable men who nevertheless possess qualifications which make them respected by all to whom they are known, for the honour of the hall is a thing apart from self. Such a system would, I believe, tend to advance greatly the beloved institution which many others and myself regard as Alma Mater.

Bedford, January 14. W. H. PRETTY.

The Transvaal Technical Institute.

IN view of various unauthorised statements which have appeared from time to time in the public Press, the council of the Transvaal Technical Institute will be obliged if you will give publicity to the following particulars regarding the arrangements which have been made to meet the needs of this community and of South Africa generally in respect of technical education.

The classes for mining students which for seven years past have been held at Kimberley are being transferred to Johannesburg, and it is expected that some forty students will be in residence here at the beginning of next academic year (February).

To provide lecture rooms and laboratories for these students, the council of the Institute has taken over from Government the lease of the Boys' High School in Kerk Street, while a row of houses in Highfield Terrace will be furnished for boarding accommodation.

The council, aided by a committee at home, is making the necessary appointments to the teaching staff. Already

Prof. Hele Shaw, of Liverpool, has been appointed senior professor, and he will be in charge of the department of mechanical and electrical engineering, with Prof. Orr, late of Kimberley, as assistant professor. The chair of mining engineering and the assistantship in that department have not yet been filled, but arrangements will soon be completed for the due carrying on of this department.

The courses at present provided by the Transvaal Technical Institute are those of the third and fourth years of the Cape mining curriculum arranged by the University of the Cape of Good Hope, but the council has under consideration the development of the Institute, so as not only to give a complete four years' mining course, but also to provide courses in other departments of engineering and technical education generally, and to provide post-graduate courses for mining engineers.

Evening classes in subjects bearing on certain trades and industries are already being carried on in Pretoria and in Johannesburg, and the council is preparing a scheme of technical instruction for mines employees and others which involves the early opening of evening and day classes along the line of Reef, and eventually in other parts of the Transvaal.

The council of the Institute has also under consideration the wider proposals recommended by the Commission on Technical Education, and it is intended that no undue delay shall intervene in the carrying out of these.

JOHN ROBINSON (Secretary).

Transvaal Technical Institute, Secretary's Office, Johannesburg, December 23, 1903.

The Quadrantid Meteor Shower of 1904.

THE evenings of January 2 and 3 were clear here, but the moon being full and near perigee, rendered invisible in the north-eastern sky all stars less bright than second magnitude. A brief watch before midnight on January 2 indicated a total absence of meteors, and it was not thought advisable to prolong observations on this night, as it had been previously determined by the writer that it was on the following night that the Quadrantid maximum would occur.

The calculated time of this maximum was January 3, 18h. G.M.T. On the same night there was an earlier, and what had been supposed would be a much weaker, maximum at 13h. Observations were therefore commenced here shortly after midnight, and it very soon became apparent that, notwithstanding the strong moonlight, shooting stars were unusually numerous. Between 12h. 5m. and 13h. (Dublin time) there were observed 17 meteors, of which 8 were as bright, or brighter, than first magnitude stars. They made their appearance at very considerable distances from the Quadrantid radiant, and, owing to the very limited number of fixed stars visible in that quarter of the sky, it was impossible to record the meteor-paths with accuracy, but several of the latter indicated a divergence from the region of Boötes, there being at the same time another probable centre of emanation near the tail stars of Ursa Major.

The advent of clouds from the south-east rendered observations impracticable or fruitless between 13h. and 14h. 15m., but during the first quarter of an hour succeeding this interruption 4 more meteors were seen, of which 2 were of first and the rest of second stellar magnitude. The early maximum of the night was now evidently declining, as in the next half hour but 3 shooting stars were visible, the two brightest of these being only of second magnitude. The two hours' interval between 15h. and 17h. was remarkable for its meteoric paucity, only 1 bright meteor equal to second magnitude having been observed during this period at 15h. 30m., though the sky was very clear; and the watch would very probably have been abandoned after 15h. but for the maximum expected some hours later. This anticipation of a recrudescence of the phenomenon was fully realised, for between 17h. and 17h. 30m. 10 meteors were observed (half of them of first magnitude), although two-thirds of the eastern sky had by this time become covered with light clouds. The meteors radiated in all directions from a region very evidently situated in the north of Boötes. In the next ten minutes 2 more Quadrantids were observed, although the clouded area had by this time increased to five-sixths. Observations were discontinued at 17h. 40m. The meteors had a fairly rapid motion, and were slightly red in colour. Their paths ranged from 10° to 20° in length. The excessive moonlight must have detracted considerably from the splendour of the present display, but, even as it was, the meteoric rate during the shower's activity was much higher on the night of January 3 than on the corresponding night in 1903.

Dublin, January 13. JOHN R. HENRY.

M. Blondlot's n-Ray Experiments.

IT would be interesting to know whether anyone has succeeded in confirming the above, as described in your columns and elsewhere.

Personally, I have repeated most of M. Blondlot's experiments, but I have not been able to discern the slightest trace of any of the remarkable phenomena that he describes. This is also the case with Mr. J. C. M. Stanton and Mr. R. C. Pierce, who have assisted me in the investigations.

In order to get away from personal physiological idiosyncrasies we have also applied delicate photographic methods of observation, but without result, and as a general conclusion I am inclined to think that M. Blondlot's observations must be due, not to physical, but to physiological processes, and further, that these are not operative in the case of all persons.

Perhaps others may have tried the experiments and may have met with greater success.

A. A. CAMPBELL SWINTON.

66 Victoria Street, London, S.W., January 19.

Phosphorescence of Photographic Plates.

SOME time ago when developing an X-ray photograph I observed the effect noticed by your correspondent in your last issue. Very little of the silver salt had been affected, and the plate, after development, when put into alum solution lit up as described. I have often watched for the same effect since with ordinary negatives; sometimes there is phosphorescence, sometimes not. Apparently a fairly long development with the pyro soda is necessary. Not only the plate itself, but the used developer will give the phosphorescence with alum solution. Dilute sulphuric acid may be used instead of the alum. Quinine sulphate or hydrochloride does not light up when the used developer is added, but will do so if a few drops of sulphuric acid are subsequently introduced. Printing out paper may sometimes be successfully used instead of the plate, or the experiment may be still more easily made by mixing potassium bromide and silver nitrate solutions in dim gaslight, decanting, and shaking up the resulting silver bromide with pyro soda. A red liquid results which gives the lighting up effect when poured into alum solution or dilute sulphuric acid.

H. J. EDWARDS.

Heaton, Newcastle-on-Tyne, January 16.

BIRD-LIFE IN WALES.[1]

ALTHOUGH the writings of Messrs. Murray Mathew, Cambridge Phillips and others have made us more familiar with the avifauna of southern Wales than we are with that of some other parts of that country, Mr. Walpole-Bond's description of the bird-life of a part of the district is not any the less welcome and instructive. For he enters very fully into the nesting habits and comparative abundance or scarcity of the birds in a way that is only possible to a good climber, indifferent to weather, who is able to devote every day wholly to the pursuit of his favourite study. The wild Wales of this book seems to lie, in the main, in part of the county of Brecon, although Pembrokeshire and other districts are touched upon. Incidentally, Bucks, Kent, and Hampshire are mentioned.

[1] "Bird Life in Wild Wales." By J. A. Walpole-Bond. Illustrated with photographs by Oliver G. Pike. Pp. xv+283. (London: T. Fisher Unwin, 1903.) Price 7s. 6d.

Wild Wales is still, happily, a stronghold of the buzzard and the raven, both of which are still fairly common there (the author seems to have had the luck to see no less than three buzzards' nests with eggs in one day), and enjoy a certain amount of protection or at least toleration, while the sight of a fork-tailed kite even may still gladden the eye of the bird lover, and we read of six seen in the air together! The management of the attempt to protect the kite in Wales, in support of which some members of the British Ornithologists' Union (which should not be called the "British Ornithological Society") have subscribed liberally, was in 1903 placed in the author's hands. Accordingly, a valuable chapter gives us an account of a nesting haunt of the kite in that year. But the birds seem to have had bad luck, despite the watchful care of the author. In the nest he found the kite addled one egg and cracked the other accidentally. A visit to Tenby in the breeding season

FIG. 1.—Merlin's Eggs in Crow's Old Nest. (From "Bird Life in Wild Wales.")

supplies material for an account of the ordinary sea-fowl to be found breeding just then. The little wader which remained unidentified was probably an immature turnstone, for many non-breeding individuals of this species pass the summer on the coast of Wales. The explanation of the light coloured shag seen on May 27 is, perhaps, that these birds do not attain adult dress in their first year, and this was immature.

Other chapters deal with the birds to be seen "in the hills" and along the river, with well-known feathered outlaws and some of the rarer birds of Wales. But the buzzard and the raven are the favourites of the author (who, indeed, devotes a whole chapter to the latter), and his personal observations on the breeding habits of these two species would alone make this pleasant book a valuable addition to the literature of the subject. The fact of the peregrine breeding in Breconshire is here recorded for the first time, and the author was lucky enough to find a merlin's nest, the second only recorded in that district. Additional interest attaches to this nest from the fact that the birds had taken possession of an old crow's nest in a tree, a most unusual thing in this country, where the merlin usually deposits its eggs on the ground or on a ledge of rock. About half the volume is occupied by an account of the author's bird-nesting and general ornithological observations on the birds of his own neighbourhood (in the form of a diary) from March to July, 1902. From these interesting pages we can gain a very good idea of the avifauna of the district, in which, by the way, the very local woodlark is to be found breeding.

The author includes a chapter of rough notes on climbing, collecting, &c., with an appeal to landowners to preserve our rarer birds. May we venture to supplement this with a hope that he will set no more traps for marten-cats? For the marten is every bit as interesting a member of our native fauna as the buzzard or the peregrine, and it is getting *very, very* rare. The author, when writing about egg collecting, states that the dealer is the worst offender in this respect, "for he stops at nothing, and will take as many clutches of a good thing as he can find." This, we fear, is quite as true of some collectors, and we must protest against the inference that the collector in general is one bit less to blame than the dealer. The collector stands in the place of "receiver," and whether or not it is true that the thief would not exist without the receiver, it is certainly true that the dealer would not exist without the collector.

As to the unsafety of "generalising" in observations all will agree. It is, perhaps, unsafe to generalise on such a subject as whether or no the curlew "seldom, if ever," lays less than four eggs. For in the case of ground-building birds, especially, the question whether a crow has visited the nest always comes in; but we have twice found three incubated eggs in a curlew's nest. If the missel thrush has usually ceased to sing in South Wales by April 15, its habit is very different in some other parts of Wales, where it may be heard well on into May. In Oxfordshire we have heard it in June. It may be pointed out with reference to the distribution of the garden warbler (p. 211) that it is common in Merionethshire, and not uncommon in parts of Carnarvonshire.

These charming pages are all the more refreshing reading because the author is evidently more accustomed to scaling crags and climbing "stiff" trees than to the making of books. All the same, a little more method in the arrangement would have husbanded space by avoiding repetition. For instance, the events of some March days detailed in the third chapter are repeated, with slight verbal variations, in the fifth, and in another place we notice that a note descriptive of bird-life recurs. The author thinks waterhen a better name than moorhen, "as one would no more expect to find one on a moor than a grouse in the river." But it may be pointed out that "moor" is an old English name for a wet meadow, and a "moorish" place is a wet place, so that moorhen was an appropriate English name for the bird long before English people had so much as heard of grouse moors.

The work is profusely illustrated with photographs of nests and bird haunts by Mr. O. G. Pike, the excellence of whose work is too well known to need further comment here. But we may direct attention especially to the clearness of the details of the sparrow-hawk's nest, the wool in the lining of the raven's nest, and the beautiful roundness of the pheasant's eggs. We do not remember to have seen a photograph of a woodlark's nest previously.

O. V. APLIN.

EARTH-MOVEMENTS IN THE BAY OF NAPLES.[1]

IN spite of the prolonged discussions on the question of changes in the relative level of land and sea in connection with the Temple of Serapis[2] at Pozzuoli, yet much remained unknown with respect to the movements of the Italian coast which it was surmised must have taken place since Roman times. An exclusive study of the columns of this building is insufficient to indicate the Roman sea-level relative to the land, for although the lowest portion of the columns, now below sea-level, was obviously above it, we cannot determine to what extent. Neither can we conjecture the size of the area affected by the movements; indeed, by the undue prominence which has been almost universally accorded to the Serapis phenomena in geological treatises, many authorities, among whom was Prof. Suess, were led to the conclusion that the phenomena were strictly local and almost confined to the Bays of Baia and Pozzuoli, in short, to the country immediately surrounding Monte Nuovo.

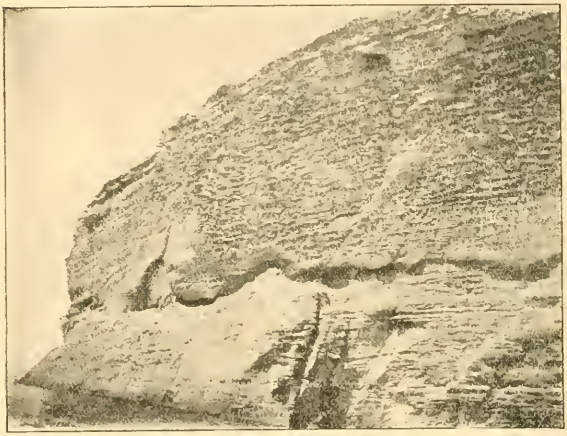


FIG. 1.—The Upper Groove of Erosion on Tufa Cliffs of Nisida.

Note the difference of the texture of the surface below the upper erosion line, which has been preserved by submergence, and that above, which has been weathered

It was with the object of collecting facts for the elucidation of these points, that we undertook the work of surveying and describing the little-known remains of Roman constructions which are so numerous around the Bay of Naples. Some of them are still standing on the present water-line, while some are awash and some deep beneath the surface: and from localities furthest from Monte Nuovo, we obtained evidence of earth-movements not less great than from localities nearer the mountain; thereby confirming our conjecture, as to the movement of the land spreading over a more considerable area than had been supposed at first.

At many points on the coast (Fig. 1), and especially in the limestone cliffs of Capri, the observer may note a clearly marked line of grooves and holes at a height varying from 23 feet to 12 feet above the present sea-level. This line, which presents the same appearance as one which traverses the rock face along the present water-line, is undoubtedly due to the same cause, namely, the eroding action of the surface of the sea. The upper marks of erosion correspond in height with the highest Lithodomus borings in the columns of the Temple of Serapis, thus showing that the entire Bay of Naples took part in the movement of the subsidence and subsequent elevation of the temple, and, as evidence of the same sort is to be found forty miles north at Gæta, and probably on the promontory of Mt. Circello as well, if atmospheric weathering has not obliterated the traces of marine erosion, the same alteration of land-level must have affected a large extent of the Mediterranean sea-board.

The changes of level have been deemed by some to be due to periodic changes in the level of the ocean. We are unable to accept this view, for we should expect the oscillations of the water-level to be of a regular and tide-like nature, as Niccolini, the eminent exponent of the theory, must himself have imagined, for the curve illustrative of his theory of marine phases is essentially a tidal curve, but the marks of erosion indicate spasmodic movements, changes of level during relatively short periods alternating with prolonged periods of rest. Another point against the theory of the change of sea-level is that the line of erosion, though continuous, varies in height; for instance, at the east end of Capri it is 10 feet higher than at the west, and smaller variations have been noted elsewhere. These facts are more reasonably accounted for by a theory of change of land-level, rendering inequalities in the oscillatory movement natural, than by a theory involving changes in the level of the sea.

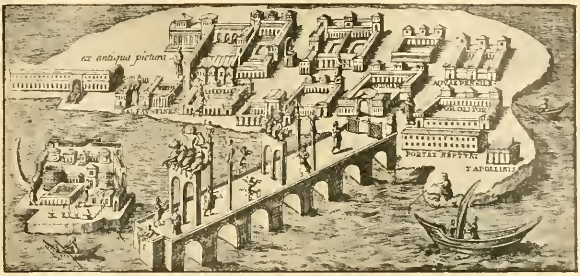
Interesting as it is to search for the traces of her handiwork that nature leaves in her own domain of rocks and cliffs, yet we confess to an interest not less keen in seeking out those she has left on the handiwork of man, on the remains of the Roman buildings by the sea. Massive piles of masonry and concrete, once part of some noble building, have been roughened by the never ceasing onslaught of the waves to the semblance of the brown rocks upon which they stand; and it is only possible to distinguish between the natural and the artificial on calm days, when they can be seen through the clear water.

It is the accumulated evidence furnished by these water-worn ruins that gives so strong a confirmation of our theory that, notwithstanding the oscillatory land-movement indicated by the upper erosion line before mentioned, the present land-level is far below the Roman land-level—how far we cannot exactly say, but we believe that the approximate figure of 17 feet will not be found to be very wide of the mark.

[1] The author's papers here summarised are:—"On the Possibility of Obtaining more Reliable Measurements of the Changes of the Land-level of the Phlegræan Fields (*Scottish Geographical Magazine*, October, 1900). "Earth-movements in the Bay of Naples" (*Geographical Journal*, August and September, 1903) "The Submerged Greek and Roman Foreshore near Naples" (*Archaeologia*, vol. lviii. pp. 1–62, figs. 1–29, plates xlv.–li., 1903). A few copies of the two last papers, reprinted with corrections, have been issued under the title "Contributions to the Study of Earth Movements."

[2] *Macellum*, or market-place, would be a more correct name for the building than "Temple of Serapis."

The evidence is of the most diverse description; masses of concrete or of Roman brickwork may be seen under water, so disposed that they show the ground-plans of the buildings they once supported; stairways with steps several feet below water are cut in the rock of caves, the walls of which still show traces of a stucco covering even where they are submerged; a drain which runs several feet below the surface, in a sea-side palace of Tiberius; artificial tunnels or *cuniculi* entirely submerged; these are but few among many other facts which have been a puzzle to antiquarians, and can be accounted for by the theory that the Roman land-level was about 17 feet higher than the present.



Pausanias Island.

Fig. .—The Breakwater of Puteoli, after a Roman Picture.

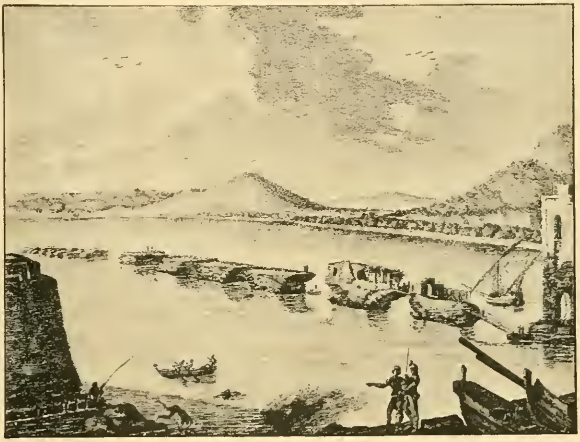


Fig. .—The Breakwater of Puteoli, after an eighteenth century drawing.

By the same theory we can explain why the malarious Lago d'Agnano was not mentioned by Roman writers, for it would not have been in existence with the land at the higher level; the present unhealthiness of the low-lying plain of Pæstum, once the site of a flourishing Greek colony, is also explained; then the Pool of Baiæ, mentioned by classical writers, and an island off Dicæarchia, described by Pausanias (Fig. 2), that have apparently vanished, we find by this theory to have been carried down by the land as it sank so that they are now covered by the sea; and finally the Roman fresco representing the famous breakwater of Puteoli Harbour (Fig. 2), which shows us the arches that join the piers or *pilae*, with the springing of the arches well above the water, is of the breakwater as the Romans saw it; nowadays the springing of the arches is submerged (Fig. 3).

These researches have thrown a new light on a point of controversy among scholars, namely, the question as to the exact site of the ancient Greek colony of Palæpolis, the mother-town of Neapolis, the present Naples. This ancient town was supposed by some authorities to have stood where Naples now is, by others to have been further inland towards Aversa. Following up our hypothesis that the shore was higher by nearly 17 feet than it is now, there would be a stretch of land extending nearly half a mile out to sea at the base of the cliffs of the promontory of Posilipo; it is here, where the ruins now under water attest to the existence of numerous buildings grouped round the Gaiola rocks, that we would place Palæpolis. Close by under the lee of this extended foreshore we discovered the defensive works of an ancient harbour, and we found many traces of an ancient coast road, also submerged, which ran along the foot of the cliffs and by tunnels through some of the little headlands on the eastern side of Posilipo (Fig. 4). This road gave an easy means of communication with the neighbouring colonies, and the many proofs we have found of its existence, as well as the geographical situation of the southern extremity of Posilipo, which was pre-eminently adapted to the conditions of Greek colony life, have emboldened us to believe that here, beneath the foundations of the later Roman edifices, the site of the vanished town is to be sought.

Fig. 4.—Ancient tunnel through Headland of the Villa Luisa, Posilipo. (After an oil painting by Mrs. Holcombe Ingleby.)

R. T. Günther.

THE ELASTIC LIMIT OF METALS.

COMMON SENSE, as Lebasteur has remarked, prevents us from denying the existence of a limit of elasticity in metals. It is true that the smallest load on a test-piece will cause a slight permanent set. Nevertheless, such structures as iron railway bridges retain their shape, and if a piece of metal is subjected to a small stress many times in succession, recovery after each application becomes almost perfect. What, then, is the elastic limit? The Commission des Méthodes d'Essai of 1894 announced that it is necessary to recognise three such limits:—

(1) The theoretical limit of elasticity or the maximum stress which does not produce a permanent strain (of more than a certain small amount).

(2) The proportional limit of elasticity, within which the strain is proportional to the stress.

(3) The apparent limit of elasticity, corresponding to the "breaking-down" point of ductile metals. Above this point, perceptible increases in deformation occur without a perceptible change of load.

With regard to these limits, M. Frémont points out, in a carefully reasoned article contributed to the September number of the *Bulletin* de la Société d'Encouragement pour l'Industrie nationale, that no one can say what is the exact difference between the first two, and that there are theoretical grounds for supposing that they ought to coincide. Moreover, the proportionality of deformation has been called in question, slight irregularities having been detected when the measurements were made with the greatest care.

These matters, however, do not greatly interest the practical man. It is not usual for the elastic limit of a consignment of steel to be tested, although it is frequently mentioned in specifications. As a general rule the breaking load only is measured, and it is assumed that the elastic limit is a definite constant fraction of this. In view, however, of the tendency of engineers to avail themselves more fully of the elastic limit, it is becoming more important to determine that limit exactly. In fact, if the elastic limit were known with a greater degree of exactness, it might be possible to practise economy by using a smaller margin of safety than is necessary at present.

Holding these views, M. Frémont set himself the task of discovering whether there is a real limit of elasticity, and if the anomalies mentioned above could be explained. Calling to mind the dictum of seventy or eighty years ago that a metal had passed its elastic limit if it had undergone a change of texture under stress, he proceeded to examine how far the microscopic structure of metals was altered by the first permanent strain.

In the class of bodies with well-marked breaking-down points, such as good mild steel, it can be readily observed in polished sections at a magnification of 50 diameters that all the grains, without exception, are clearly deformed at what seems to be the real elastic limit. These bodies are nearly homogeneous, and if part of a test-piece is permanently deformed, the line of demarcation is clearly defined on a polished surface by the deformed part becoming dull, the change being visible even without magnification. In general, however, the first deformations are local, owing to the unequal distribution of stresses. It is almost impossible to adjust the test-piece so that the force may act in a straight line in the direction of its axis, and so the test-piece is generally deformed obliquely. Local action is strikingly illustrated by the fracture of some cast-iron or other hard non-ductile test-pieces at a place in the head where the section is greater than elsewhere.

Various devices have been invented to overcome this defect, but in none of them is any account taken of the effect of stress-hardening. The effect is well known, and may be readily demonstrated by a simple experiment. Mark a prismatic test-piece with a punch, and then file off the mark and polish the metal. If the prism is then compressed between two end-pieces the mark will reappear as soon as the elastic limit has been sufficiently passed. The stress-hardened parts resist more than, and do not lose their polish so easily as, the unaltered portions of the test-piece. The principle is the same as in the magic mirrors of the East, and the effects are observable in actual tests. Traces of striæ, file-marks, the marks made by the jaws of the vice in which the test-piece was held while it was being prepared, all reappear in the course of testing. Similarly, if the force in testing is not applied equally, the part which bears the greatest stress will be deformed first, and *ipso facto* hardened and strengthened. The first giving-way of the metal causes the pressure to be more evenly distributed, but the irregularity of pressure is succeeded by irregularity of resistance, which continues to the end of the test.

In some experiments on homogeneous boiler-steel M. Frémont found that a permanent set could be obtained in compression tests under loads varying from 8.55 to 15.70 kilograms per square millimetre, but judging from the dulling of the polished section, the deformation was always local, and the elastic limit was not passed, except in isolated patches of the metal.

After painstaking but vain efforts to adjust the force accurately, he fell back on the use of test-pieces of gradually increasing section. Then the first irregular deformations occurred in the weakest section; there was a local sinking and adjustment, and the discontinuous dulled lines tended to lie flat at right angles to the force. As the force increased the lines approached each other, and coalesced to form a continuous sheet the area of which could be measured and compared with the stress.

In Fig. 1 the effects of compression are shown on the four polished faces of a test-piece having the shape of a truncated pyramid. The first effects are quite discontinuous, the dark lines near the upper part of the top row of photographs showing the areas which have received a permanent set. In the second row the effect of a maximum pressure of 1015 kilograms is shown. In the third row, under a pressure of 1155 kilograms the discontinuous lines have coalesced, and the deformation has been made to advance as a continuous sheet, the area of which amounted to 46.8 square millimetres, so that the real elastic limit was found to be 24.60 kilograms per square millimetre. The last two rows of photographs show the effects of pressures of 1295 kilograms and 1435 kilograms respectively, corresponding to elastic limits of 24.80 and 24.65 kilograms per square millimetre. The same metal was used as that which underwent local deformation in an ordinary trial under a pressure of 8.55 kilograms per square millimetre of the whole section.

Similar results were obtained by M. Frémont in tension tests. The first deformations were apparent under a force of 8.5 kilograms, although the real limit of elasticity was certainly above 21.5 kilograms. Tests on thin flat test-pieces of increasing section gave results shown in Fig. 2, where the strained parts, at first discontinuous, subsequently form a continuous sheet.

The conditions are different in determining the elastic limit of the class of bodies which show no definite breaking-down point. The members of this class, which includes hard steels and metals of small elongation, are less homogeneous, and consist of networks of substances of different elastic limits. In the

first permanent deformations some grains only are deformed slightly, and as the stress augments more grains are deformed, and the deformation of the others increases. No definite dulling of the polished metal visible to the naked eye takes place, and the effects must be studied by means of the microscope. The polishing must also be done with the greatest care. The line of demarcation between the permanently strained and unstrained parts is even then always confused, and its exact position a little doubtful, but otherwise there is no difference between the testing of the two classes. In all cases the surface to be examined must be polished, for a scale of oxide has an elastic limit different from that of the metal underneath, and its indications are untrustworthy.

Similar results are obtainable in tests of flexion, torsion, &c.

By his experiments M. Frémont has proved that the

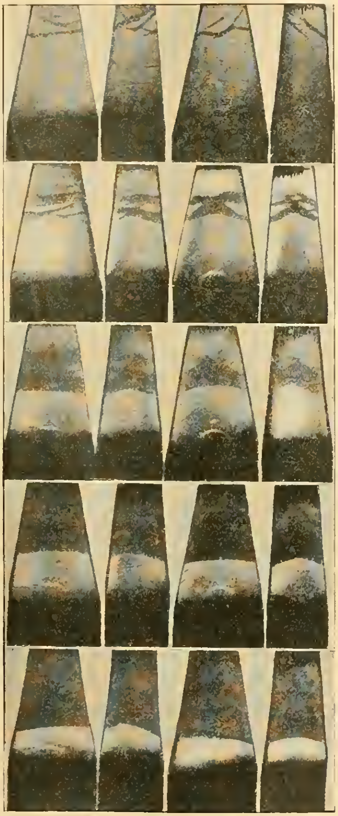


FIG. 1.—The dark areas at the upper parts of the test pieces show where the metal has given way under compression.

theoretical elastic limit is the mean charge per unit of section on which the real elastic limit is locally attained at a point of the piece tried. It is not the elastic limit of the metal, but of the particular piece of metal under the special conditions employed. Its value depends on care in adjustment, &c.

The proportional elastic limit is still more fortuitous. Owing to compensating errors the line showing the relation between stress and strain may continue to be fairly straight even above the theoretical limit.

The apparent limit is the mean charge per unit of section when the real elastic limit is reached in all regions where it had not previously been reached. It is nearer the real limit but is not identical with it, because the charge is unequally distributed between the parts that have been previously hardened and those that are not yet hardened.

When the appearance of the lines of Lüders, which are now seen to be portions of metal which have given way, does not precede the continuous sheet, the theoretical limit and the apparent limit will coincide with the real limit. Generally, however, the lines come first and then the various limits will not coincide.

The nature of the metal has also an effect, for in annealed steel the two limits are nearer than in hardened and tempered steel.

To sum up, M. Frémont claims with much force that there is only one elastic limit of a metal, the "real elastic limit," as determined by the method he indicates. The real limit alone has the characters of a physical constant. The other so-called limits depend on the appearance of discontinuous deformations, the presence of which is almost inevitable in practice, although their cause is purely accidental.

T. K. R.

FIG. 2.—The dark areas on the test pieces correspond to the portions of the metal which have given under tensile stresses.

PREHISTORIC STUDIES IN AUSTRIA.

THE concluding part of the first volume of reports of the Prehistoric Committee of the Vienna Academy of Sciences has recently been published.[1] In former parts accounts have been given by Dr. Szombathy of excavations in the well-known cemetery at Hallstatt, of tumuli at Gemeinlebarn and Langenlebarn, and of the cemetery at Idria. Dr. Franz Heger has also treated of work carried on at Hallstatt in 1877 and 1878, as well as of various researches in Hungary and Lower Austria, while Dr. Moriz Hoernes and others have communicated valuable reports.

The part now issued contains two reports. The first, by Julius Teutsch, relates to some late Neolithic settlements with painted pottery in the valley of the Alt or Aluta, in the neighbourhood of Kronstadt, in Transylvania. A remarkable feature in one of the de-

[1] "Mittheilungen der Prähistorischen Commission der Kais. Akademie der Wissenschaften." 1 Band. (Vienna: Carl Gerold's Sohn, 1903.)

posits is the presence of stamps made of burnt clay with spiral devices upon them, which it is suggested may have served for producing coloured patterns on the human skin after the manner of tattooing. A few fragments of pottery are also decorated with spirals formed of white slip on a polished red ground, but bordered by lines painted in black. A favourite decoration consists of broad lines either straight or curved, and sometimes circular, distinguished by black edgings.

Spoons or ladles are fairly abundant, some having straight handles adorned with chevron and other patterns painted upon them. Human and animal figures in burnt clay occur, though rarely. Remains of beaver, bear, wolf, fox, lynx, wild cat, chamois, stag, and ox (possibly *primigenius*) have been found, and of domesticated animals, those of dog and pig.

Relics of a somewhat later age are also described, but the principal feature of the report is the pottery, which it will be of great interest to compare with that of a more southern area.

Dr. Moriz Hoernes, whose recent volume on "Diluvial Man in Central Europe" is well known, is author of the concluding paper in this volume. It relates to Neolithic dwelling-places near Troppau, in Austrian Silesia, and is illustrated by six admirable photographic plates and numerous cuts in the text. A remarkable stone hatchet has been found which was made out of the half of a perforated axe that had split along the perforation. Another hatchet shows the mark of the saw by means of which it was blocked out. The pottery is not remarkable, though there are among the specimens figured some stands for vessels not unlike those found by the MM. Siret in Spain. The objects found are, indeed, of a more common character than those from Transylvania. It is, however, of great importance that in a volume of reports such as that now summarised, all details of the discoveries on each spot should be carefully recorded, and the Prehistoric Commission of Austria may well look back with much satisfaction on the volume embodying the results of its labours.

J. E.

NOTES.

THE Secretary for Scotland received on Tuesday a deputation of Scottish scientific societies, who urged that the Royal Institution in Edinburgh should be exclusively devoted to scientific purposes (see p. 105).

WE regret to see the announcement, in the *Daily Chronicle*, that Mr. J. S. Budgett, Trinity College, Cambridge, died at Cambridge on Tuesday of malarial fever. Mr. Budgett was Balfour student in biology, and only returned from the Niger recently.

THE Clarke memorial medal of the Royal Society of New South Wales has been awarded to Mr. A. W. Howitt, of Melbourne.

THE Food Test Commission, appointed by the United States Government, has reported that the use of salicylic acid in food is seriously injurious to health.

PROF. VINCENT RODELLA, of Rome, is reported to have met his death accidentally by inhaling the fumes of hydrocyanic acid in the course of some experimental work. He was only thirty years of age.

MESSRS. BURROUGHS, WELLCOME AND CO. are making arrangements for a historical exhibition of rare and curious objects relating to medicine, chemistry, pharmacy, and the allied sciences, to be held in London in the course of a few months. The exhibition will be strictly professional and scientific in character, and is intended to illustrate the development of the art and science of healing. Cooperation is invited, and it is hoped that many objects of interest will be lent for exhibit. Mr. H. S. Wellcome, Snow Hill Buildings, E.C., will be glad to give particulars of the undertaking.

BY the terms of Mr. Herbert Spencer's will, the trustees, on the completion of certain specified provisions in connection with his books, are directed to sell the whole of the copyrights and other property. The trustees are also directed to "give the sum realised in equal parts to the Geological Society, the Geographical Society, the Linnean Society, the Anthropological Institute, the Zoological Society, the Entomological Society, the Astronomical Society, the Mathematical Society, the Physical Society, the Chemical Society, the Royal Institution, and the British Association, or such of them as shall then be in existence, and shall accept the gift upon the condition in each case that the sum received shall, within five years from the date of payment, be spent by the governing body for the purchase or enlargement of premises, or for books or apparatus, or collections, or for furniture or repairs, or for equipment, or for travellers and donations of instruments of research, but in no way or degree for purposes of endowment."

AN interesting paper on the electrical reconstruction of the South London tramways was read by Mr. A. Millar before the Institution of Civil Engineers on January 12. The paper describes in great detail the conduit system which has been employed. The lines which have been electrified are those known as the Tooting lines; the route length is just more than 8 miles, and the total length of single track 16¾ miles. The same system has been adopted for the Greenwich lines of the London County Council.

THE council of the Institution of Civil Engineers has nominated the president, Sir William White, K.C.B., F.R.S., to fill the place of the late Sir Frederick Bramwell, Bart., as one of the representatives of that Institution on the Engineering Standards Committee.

WE have received a copy of a pamphlet on the use of electricity in mines in Europe, by M. Émile Guarini, which has been translated into French from the *Engineering Magazine*. The pamphlet is well illustrated, and gives in detail descriptions of the principal applications that have been made of electricity to mining work. These are already numerous, but there is still much room for their further extension. We can recommend this pamphlet to those interested in the subject, whether as mining or as electrical engineers.

THE completion of the Great Northern and City Railway marks another step in the progress of the provision of proper transport facilities in London. The new "tube" does not differ much from its predecessors in the general features of its construction and electrical equipment. It is, however, the largest of all in diameter, being large enough to accommodate, if necessary, the existing rolling stock of the Great Northern Railway. Special precautions have been taken in the construction of the tunnel to guard against the risk of fire and to lessen the chances of vibration. The railway will be open to general traffic in a few weeks. It has taken just four years to complete; an extension of the line from Moorgate Street to Lothbury is now in progress.

DR. H. R. MILL has sent us a copy of a very handy pocket register which has been prepared by him for the personal use of rainfall observers. It contains full instructions for

placing the rain-gauge, forms for recording the daily readings of one or several instruments, monthly summaries, and the extreme daily falls in each month. It also contains some useful memoranda connected with the subject, and, for convenience of comparison with other stations, the average monthly falls of several types, from the driest to the wettest localities. Space is also provided for recording the general conditions of weather, wind direction, &c. Suggestions for improvement are solicited; we do not think he has left much room for improvement, but we suggest that the Beaufort weather notation or the international weather symbols might be a useful addition to the work.

WE have received from the Meteorological Office a list of the meteorological observations received there from colonial stations in various parts of the world. During the year 1902 manuscript returns were received from sixty-two stations, more than half of which are situated in Africa. The amount of the information received varies considerably; at some stations complete registers have been kept, while at others only the daily rainfall has been observed. The list also contains a statement of the printed observations received either direct from the colonies and protectorates or which are included in books in the possession of the Office. It may not be generally known, although the fact is published in the annual reports issued by the Meteorological Council and in circulars issued from time to time, that this valuable information, both manuscript and printed, is available for reference free of charge by permission of the secretary.

IN his interesting and stimulating address on "A Scheme for Exploration in Asia Minor," recently given before the Society for the Promotion of Hellenic Studies, Prof. W. M. Ramsay suggested the formation of a summer school of exploration in Asia Minor. The scheme, briefly, was the conducting of parties of young men by an experienced leader to various regions of Asia Minor; a suitable town would be selected for the headquarters of a party, from which excursions could be made. All those who have done field work far removed from home find that there are elements of uncertainty in their notes which a very short inspection of the original ground, or a few minutes' conversation with a native, would dispel, but which have to remain doubtful owing to the difficulty or impossibility of returning to the place. Prof. Ramsay wisely proposes that the students should write up all their notes at the centre, and thus verification would be easy. There are many other branches of science which admit of similar developments. Field work is often undertaken in the long vacation, but it is frequently desultory; what we now require is the combined action of several universities for well planned field work in geology, geography, botany, zoology, and anthropology, including archæology and ethnology. Such practical work should be considered as part of the academic curriculum, and it is certain that these would become still more living subjects in our universities if the undergraduates felt that they were making original investigations in the field, while the students themselves would greatly benefit by this new departure.

IN the *Entomologist* for January the Hon. N. C. Rothschild describes four new species of fleas taken on Egyptian rodents. Others are described by the same writer in a recent issue of *Novitates Zoologicae*, one of which is named in honour of Mr. O. Thomas.

IN the report of the Bristol Museum and Library for 1903, the committee directs attention to a fine series of heads of large mammals from Somaliland, collected and presented by Major H. G. C. Swayne, R.E., the discoverer of *Bubalis swaynei*. A photograph of the group is included in the report.

THE *Journal of Conchology* for January contains three papers on the small fresh-water gastropods of the genus Paludestrina. In the first Messrs. Jackson and Taylor have notes on the habits of a species named from British specimens in 1891; in the second Mr. Tomlin records for the first time the continental *P. anatina* in Britain; while in the third Mr. Dean describes the relation of fishes to *P. jenkinsi*.

THE regeneration of lost parts in various invertebrates forms the main topic in vol. lxxv., part iii., of the *Zeitschrift für wissenschaftliche Zoologie*, Mr. P. Imanow contributing an article on this subject in connection with a species of worm, while Dr. E. Schultz contributes two instalments of the account of his investigations on reparation of injury in general. In a fourth article Dr. O. Römer discusses the histological structure of the shell of certain bivalves, more especially the pearl-oyster. The skin-nerves of Ammocœtes form the subject of an essay by Dr. G. Marenghi.

ACCORDING to the *Daily Telegraph*, whalebone has been recently sold in America for 2900*l*. per ton, while it is also asserted that 3000*l*. per ton has been paid for two and a quarter tons at Dundee, although there seems to be some degree of doubt attaching to the latter statement. Soon after the middle of last century, the price of this commodity was as low as 150*l*. per ton, but, according to the late Frank Buckland, it suddenly leapt up to 620*l*. with the introduction of the "crinoline" into ladies' costume, and it has apparently been on the rise ever since.

IN the January issue of the *Popular Science Monthly* Dr. F. A. Bather, of the British Museum, returns once more to his favourite subject—the functions of museums. After mentioning the chief functions of these institutions, the author gives some much needed advice to the curators of local museums as to the necessity of firmness in refusing unsuitable specimens—if they do not wish the establishments under their charge to degenerate into mere curiosity shops. Small local museums are also warned that investigation is not their province—they are for education and the general public needs alone. Further, in larger establishments the investigation, the instruction, and the exhibition series must be kept apart. In the author's opinion, where museums have, as a rule, gone wrong is in exhibiting too much to the public. The same journal also contains an admirably illustrated article by Prof. T. A. Jaggar, of Harvard University, who was present at the time of the eruption of Mont Pelée on July 9, 1902.

WE have been favoured by Captain Barrett-Hamilton with copies of two papers recently contributed by him to scientific journals. In the one (*Proceedings* Royal Irish Academy, xxiv., part iv.) he describes a new bank-vole (*Evotomys scomerensis*) from Skomer Island, off the coast of Pembroke, which differs from *E. glareolus* of the mainland by its superior size, its colour, and the structure of the skull. In the second (*Ann. Mag. Nat. Hist.*, series 7, xi., p. 390) he records the result of his own observations on the flight of the true flying-fishes (Exocœtus), which differs to some extent from those of other recent observers. Captain Hamilton, who is in this respect in full accord with the late Prof. Möbius, is of opinion that, at any rate in the genus named, the "wings" are never moved as organs of

true flight. "They may vibrate or quiver under the action of air-currents or the shifting a little of their inclination by the fish; but the whole motive power is supplied by the powerful tail. The wings are a parachute to augment the action of this propeller. Their motions are in no way comparable to those of the wings of a bird."

THE January number of the *Journal of State Medicine* commences a new series, and the *Journal* has been enlarged and much improved in appearance and in printing. It includes articles and papers by Prof. Hueppe on tuberculosis, Mr. Lloyd on the milk supply of large towns, Dr. Coles on acid-fast bacteria, Prof. Smith and Dr. Sommerville on the standardisation of disinfectants, and Prof. Hewlett on ankylostomiasis, with a translation of Prof. Behring's article on tuberculosis, together with chemical and legal notes, reviews, &c.

IN the current number of *Climate* the work that has been done by the London and Liverpool Schools of Tropical Medicine is reviewed, and Sir Patrick Manson's address on the former is given *in extenso*. An extract from a despatch from Sir William MacGregor, the Governor of Lagos, suggests the introduction into the elementary schools in the tropics of the subjects of hygiene and sanitation. Sir William MacGregor has already taken the bold step of including sanitation with reading, writing, and arithmetic as compulsory subjects in the schools of the Lagos colony receiving Government grants. A description of the Livingstone College and some technical papers complete the list of articles appearing in this useful periodical.

IN a communication to the Paris Académie nationale de Médecine (December 8, 1903) Dr. J. A. Rivière gives an account of the results achieved by him in the treatment of inoperable malignant growths by physicotherapeutic means, *i.e.* by a combination of X-rays, static electric discharges, and discharges of high frequency, together with the administration of calomel and quinine internally to promote elimination. The effect of the treatment is to cause a diminution in the size of the growths, disappearance of enlarged glands and of œdema, abolition of pain, and healing of ulcers, together with an improvement in the general condition of the patients.

IN a report on the second outbreak of plague at Sydney in 1902 just published, Dr. Ashburton Thompson describes in detail the management of the epidemic, and discusses the mode of spread of the disease. Both in this and in the previous epidemics the disease seems to have been undoubtedly rat-borne, and it is of interest that an outbreak occurred among the animals in the Zoological Gardens. The mode of spread of the disease from infected rats to man has been a much debated question, Simond, Tidswell and others maintaining that the fleas serve as the intermediaries, while others, notably Galli-Valerio, deny this on the ground that the rat fleas do not bite man. Further observations have been made on this point by Dr. Frank Tidswell, microbiologist to the Sydney Board of Health. The species of flea infesting the rat (at Sydney) in order of frequency are:—*Pulex pallidus*, *Pulex fasciatus*, *Typhlopsylla musculi*, and *Pulex serraticeps*. Of 101 fleas obtained from man, 85 were *Pulex irritans* and 16 were *Pulex serraticeps*; from a wallaby, dogs and cats, numerous specimens of *Pulex serraticeps* were obtained; thus there is one species common to man, the rat, and other animals. The objection, therefore, that the "rat flea" does not bite man falls to the ground as regards one species, and Dr. Tidswell further states that he has repeatedly observed both *P. pallidus* and *P. fasciatus* bite man. Reviewing the evidence, therefore, Dr. Thompson is of opinion that Simond's hypothesis of "flea borne plague" best explains the phenomena of the epidemic of the disease as seen at Sydney.

THE report of the Botanical Exchange Club of the British Isles for 1902 is edited by Mr. Arthur Bennett. Mr. C. Bailey gives a list of some interesting plants which he found on the sandhills at St. Anne's, Lancashire, and figures *Ambrosia artemisiaefolia* and *Vicia villosa*. Mr. G. C. Druce has been able to reinstate another of Don's doubted records by finding the grass *Deyeuxia neglecta* in Caithness.

IN the *Proceedings* of the Boston Society of Natural History Mr. C. A. King describes certain stages in the life-history of Araiospora, a genus allied to the common plant parasite Pythium. The chief points of interest are the formation of a fertilisation tube, not by the antheridium, but by the oogonium, and the specialisation of a central mass of protoplasm in the oogonium in which the male and female nuclei meet. The author places the genus in the Peronosporeæ.

WE have received a copy of an address by Dr. Rudolf Blochmann on "Die drahtlose Telegraphie in ihrer Verwendung für nautische Zwecke" (Leipzig and Berlin: Teubner, 1903), given at the thirty-fourth annual meeting of the German Nautical Society at Berlin in February, 1903. It consists of a very general description of the methods used in wireless telegraphy and of the author's views as to the future in store for wireless methods. Stress is laid on the utility of such methods in the case of fogs at sea.

A TRANSLATION into French of Prof. T. Jeffery Parker's "Lessons in Elementary Biology," by Dr. A. Marie, has been published by M. C. Naud, of Paris.

THE third and concluding volume of Mr. C. Raymond Beazley's "Dawn of Modern Geography" will, it is hoped, be ready for publication early next year. It will be issued by the Oxford University Press, to which Mr. Murray has transferred the volumes already published. Dr. M. Aurel Stein has undertaken, with the official sanction of the Secretary of State for India, a complete account of the results of his researches in Chinese Turkestan. The book will be published by the Oxford University Press, probably in the spring of 1905.

THE "Year-book of New South Wales," compiled by the editor of the "Year-book of Australia" by authority of the Government of New South Wales for circulation by the Agent-General in London, contains much information of value about the colony. In addition to particulars concerning administrative, commercial, and other matters, the volume provides an interesting account of the geographical characteristics of the country, its water supplies, and its mineral products. In fact, the publication contains all the data necessary to enable a prospective emigrant to form a good idea of New South Wales.

THE current number of the *Quarterly Review* contains two articles on subjects of scientific interest. The first is on the metric system of weights and measures, and in it the writer examines exhaustively the arguments for the compulsory adoption of the metric system. He comes to the conclusion "that the stock arguments of the advocates of the metric system, based on the extent to which it prevails abroad and the disadvantage to British trade of our adherence to a different system, have very little justification

when we consider our whole trade, import and export, with our colonies and with foreign countries." The "analysis of the conditions of our foreign trade," the article states, "leads us back to the ground that the advocates of the change would do well never to have quitted, viz. the comparative merits of the metric and imperial systems. . . . As regards all such important points as logical arrangement and symmetry, ease and swiftness of calculation, simple and direct connection among the fundamental units of length, weight, and volume, there can be no possible room for doubt as to the vast superiority of the metric system." The other article is by Mr. W. C. D. Whetham, and is entitled "Matter and Electricity." It gives a good and complete account of the scientific work of the last seven years, or so far as radiation and radio-activity are concerned. The researches of Becquerel, J. J. Thomson, Rutherford, the Curies, Crookes, Dewar, Ramsay, Soddy, and others are passed in review, and a clear idea is given of what, in the opinion of the best authorities, is the probable physical significance of the results obtained.

THE December number of the *Agricultural Students' Gazette* (Cirencester) contains a lecture given at the college by the new honorary professor of forestry, Dr. W. Schlich, which is of special interest in view of the attention which forestry and education in forestry are receiving at present. By an appeal to figures, the professor showed that the demand for timber in this country increases steadily, and that our foreign supplies rest on an unsafe basis. The British forester has therefore a double incentive to mend his ways, for not only is there the prospect of an advance in prices, but he may, if he will, replace by home-grown timber part of the present imports. In discussing the question, "Will it pay?" Dr. Schlich had to confess that British forests supplied him with no satisfactory data, for none has been sufficiently long under scientific direction, but he was able to show what had been done by Saxony under conditions which are not very different from ours. The forests of that State, which occupy close on half a million acres, have been systematically worked by the Government for more than a century, and since 1817 records have been kept. In 1817 the produce was 61 cubic feet, in 1893 92 cubic feet of timber per acre; while the net return eighty years ago was 4*s*., and in 1900 was 22*s*. 6*d*. per acre. After discussing the cost of production, the lecturer said he estimated that a purchaser who was content to accept 2½ per cent. for his money might pay for land for oak growing 9*l*. 10*s*., for spruce 15*l*., for ash 24*l*., and for larch 34*l*. per acre. As oak requires a much better soil than spruce or larch, it is evident that the profits from growing timber will vary widely with the species grown. The above figures, however, do not take account of diseases, and these sometimes seriously affect profits. Larch, the most valuable of our trees, readily falls a prey to *Peziza Willkommii*, and so destructive has this parasite become of late years that Dr. Schlich fears it may make profitable larch cultivation impossible.

IT appears from the work of the expedition under Colonel Spindler, which has lately explored the Gulf of Kara-bughaz, that this interesting appendix of the Caspian Sea has a great commercial value, its bottom being covered with immense layers of nearly pure Epsom salt (mirabilite). This large gulf, which covers 7080 square miles, and has only a depth of from 34 to 36 feet, is now separated from the Caspian Sea by two narrow sand peninsulas which are nearly joined at their ends, leaving only an 86 fathoms wide channel, through which the water of the Caspian continually rushes into the gulf, to be evaporated there, leaving its salts to be deposited at the bottom. From 18 to 33 cubic kilometres of water enter in this way the gulf every year, and under the rapid evaporation which goes on there (3·2 feet per year) the salinity of the water in the gulf attains as much as 16·3 per cent. Consequently, the bottom of the Kara-bughaz consists now to a great extent of gypsum or of Epsom salt, and it is calculated by the chemist of the expedition, A. Lebedintseff, that the deposits of pure Epsom salt must cover an area of about 1300 square miles, and have a thickness of 7 feet or more. Owing to the small depth of the gulf, this salt can easily be extracted by means of excavating machines.

THE additions to the Zoological Society's Gardens during the past week include a Rhesus Monkey (*Macacus rhesus*) from India, presented by Mrs. Hughes; a White-backed Piping Crow (*Gymnorhina leuconota*) from Australia, presented by Mr. H. Brack; a Ring-necked Parrakeet (*Palaeornis torquatus*) from India, presented by Mrs. Watts; three Yellow Baboons (*Papio cynocephalus*) from Africa, three Impeyan Pheasants (*Lophophorus impeyanus*) from the Himalayas, two Rufous Tinamous (*Rhynchotus rufescens*) from Brazil, two Tuatera Lizards (*Sphenodon punctatus*) from New Zealand, deposited.

OUR ASTRONOMICAL COLUMN.

INTENSITY OF ATMOSPHERIC LINES IN THE SOLAR SPECTRUM.—The results of an interesting research on the intensities of the atmospheric lines in the solar spectrum are published in No. 8, vol. xlviii., of the Harvard College Observatory *Annals*. The widths of various lines in the D, α and B regions were measured on the solar spectrum charts prepared by Higgs under various recorded atmospheric conditions and solar altitudes. The results thus obtained, after suitable reduction to standard conditions, were analysed, and in cases where a difference exceeding a fixed minimum was found to exist between the width of a line at "high" sun and its width at "low" sun, this line was attributed to absorption in our atmosphere. The lines thus determined as "atmospheric" were compared with those similarly designated by Rowland, and in a few cases in each region the decision of that observer, as to whether a line was truly solar or atmospheric, has been reversed.

Measurements of the widths of six atmospheric lines between λλ 5867·8 and 5905·5 were made on sixteen charts, and the results arranged in a table in which the charts were placed in order of the sun's altitude at the time each chart was drawn. According to the general result the lines should show an increase of width proportionate to the lengths of the paths of the rays through our atmosphere, this increase of width being probably due to the moisture present in the atmosphere. Some abnormal widths were, however, noted, and were found to agree, in effect, with Higgs's remarks as to the state of the atmosphere at the times the respective charts were made. From these results it is concluded that this method is probably the most accurate one known for determining the total amount of moisture, in the line of sight, in the earth's atmosphere.

OBSERVATIONS OF JUPITER.—Some interesting results of observations of Jupiter during 1903 are published by Mr. Denning in No. 340 of the *Observatory*. Between May 26 and November 19 the planet was observed on eighty-four nights, 1200 transits of various markings being observed. It is proposed to continue the observations until the end of the present month, and then to publish the complete results. A few of the more important points in the observed phenomena may, however, be mentioned now.

During the six months completed at the end of November the rotation perod of the Great Red Spot became somewhat lengthened, the mean value being 9h. 55m. 41·7s., as compared with 9h. 55m. 39·0s. in 1902. The large south tropical spot, visible since the spring of 1901, is still easily seen, and has a rotation period of 9h. 55m. 19s. This spot

covers 48° of Jovian longitude, and its centre will be in conjunction with the centre of the Great Red Spot in June, 1904. Differences of period have been exhibited by three of the most conspicuous spots situated on the red, narrow belt north of the N. equatorial belt, their respective periods being (1) 9h. 55m. 35·8s., (2) 9h. 55m. 31·5s., and (3) 9h. 55m. 26·6s. Greater differences of rate have been shown in the N. temperate and N.N. temperate spots, one group of six showing a period of 9h. 55m. 57s., whilst the observed period of another similar group of six was 9h. 55m. 40s.

MERIDIAN CIRCLE OBSERVATIONS OF EROS AND NOVA PERSEI.—The results of the Harvard meridian circle observations of Eros and the comparison stars are published in No. 6, vol. xlviii., of the Harvard College Observatory *Annals*. The comparison stars are those given in *Circulaire* No. 4 of the Conférence Astrophotographique Internationale, and were observed over bright wires in a dark field. Tables showing the elements of the reduction of the observed places are given, and are followed by a table showing the position of Eros on six evenings in November and one in December, 1900.

No. 7 of the same volume of the Harvard College Observatory *Annals* contains the results of the meridian circle observations of Nova Persei and comparison stars. The observations and reductions were similar in character to those made for Eros—except that Nova Persei was observed in a red field over dark wires—and have been made by the same observer, Mr. John A. Dunne. The final table gives the magnitude, the apparent and mean places, and the 1900·0 positions of the Nova, as determined on fourteen dates between February 24, 1901, and January 24, 1902. The observations have all been reduced to Auwers's system of star-places.

PERIODICAL COMETS DUE THIS YEAR.—Mr. W. T. Lynn, in a letter to the *Observatory* (No. 340), gives a short account of the following periodical comets which are due to return to perihelion during this year. Winnecke's comet should become visible in the early part of the year, as it performed its previous perihelion passage on March 20, 1898, and has a period of about 5·8 years. Tempel's comet (1873), having a period of about 5·28 years, was observed on its return in 1894 and again in 1899, and in the latter year it passed through perihelion on July 28. It should therefore return towards the end of the present year.

The now familiar object discovered by Méchain in 1786 and known as Encke's comet has been observed at every return since 1818–19, and should be visible again during the latter end of this year. The period is about 3·3 years, and the last perihelion passage took place on September 15, 1901.

RECENT CONFERENCES OF SCIENCE TEACHERS.

YEAR by year the conferences arranged by the Technical Education Board of the London County Council have increased in importance. This January no less than 850 teachers attended the meetings—which occupied three whole days, January 7, 8 and 9—at the South-western Polytechnic. Moreover, a valuable and suggestive exhibition of matters dealing with its special subject, arranged by the Geographical Association, was opened two days before the conferences began, and the collection remained on view until they ended.

Mr. A. J. Shepheard, chairman of the Technical Education Board of the London County Council, presided over the first meeting on January 7, and gave a very cordial welcome to all present. His opening address dealt with the conclusions which he, as a member of the Mosely Commission, had drawn from his recent visit to the United States of America. By way of introduction Mr. Shepheard very briefly indicated the steps that led up to the inquiries which Mr. Mosely had boldly instituted. The fact that American engineers had succeeded in mining operations when Englishmen had failed raised the question as to whether the success was due to American education. The commission, upon which Mr. Shepheard served, resulted, and it was intended to determine whether there were any points in American education which are superior to our own.

Mr. Shepheard found that in America there was a more largely diffused spirit of education and a greater belief in its necessity and value than here in England. The American people were taught to cherish the idea that they had a right to the best education possible, and at the expense of the State; while the State recognised clearly its duty in this respect, and regarded such work as the best investment that it could make.

Here there is an undoubted lesson to England, and Mr. Shepheard strongly urged all who believe in education, not to let the matter rest until every citizen feels that this nation will never be what it ought, until everyone is educated to the fullest extent to which he or she is capable. America, Mr. Shepheard went on to say, was fortunately free from "the religious difficulty," and in this country in future, sectarian questions must be strictly kept in the background. Education in America is free up to the age of eighteen years, and the universities are more open than here. The manner of teaching is more practical, and without losing our reputation for culture we might consider this point more. The value placed upon nature-study in the United States was considered by Mr. Shepheard, who dwelt upon observational work, painting from nature, weather notes, and the consideration of all natural objects of interest. Finally, Mr. Shepheard discussed manual training, the trade high schools, and the career of a student in such institutions as the Boston Technical School and the universities.

Mr. H. J. Mackinder, reader in geography to the University of Oxford, contributed the first paper, entitled "The Development of Geographical Teaching out of Nature-Study." He digressed for a moment to point out that there was no great antithesis between culture and practical education. We are creatures of history, and we have chosen different methods of cultivating imagination from those adopted by the Americans. Geography, he said, was calculated to expand the imagination, and should start with the home. He quoted the paragraph on the scope of nature-study from the judges' report of the exhibition held in 1902, and proceeded to show that geography, as now understood, followed many of the same paths. Mr. Mackinder sketched out some excellent methods of teaching geography, beginning with the construction of a rough plan, and discussed the use of globes and maps without lettering before dealing with such as are commonly used, and which, as he says, tend to dwarf the imagination. He had something also to say about the far-reaching commercial importance of geography, and all right thinking people will support his plea that the idea be at once stamped out which implies that the British possessions can be studied apart from the world as a whole.

At the afternoon meeting Sir John Cockburn in a telling manner summarised from the chair the various matters at issue. Mr. Kendall, of the Yorkshire College, Leeds, described some ingenious methods of filling in the steps of models (made up of thicknesses of cardboard cut according to contour lines) with dry material, which is set by having water sprayed upon it.

Mr. J. Lomas, when treating of excursions, gave a description of a ramble along the banks of a tiny stream in Cheshire. He showed with the help of some specially prepared lantern slides, the questions which it, in common with larger rivers, asks and—yielding to the careful observations of the nature student—likewise answers. Why is here a waterfall? Why is there a patch of sand? The fact that the stream is small is a great help in determining what has altered and is altering its course, and in making experiments to determine the direction of various currents. Mr. Lomas concludes that the object of teaching should be to see that the pupil receives correct impressions, and the only way, he says, to secure this is by observation.

Dr. A. J. Herbertson showed by means of a lantern a number of Ordnance maps illustrating typical regions, and considered the points that go to make a good map. He alluded also to the issue of Ordnance Survey maps to schools for teaching purposes (owing to recommendations of the Geographical Association) at a cost of 25*s*. per hundred for outlines and 35*s*. for the same number when hill-shading is added.

Mr. T. Alford Smith gave an account of the use of simple

globes in his class, and showed how a lantern may be used with them to explain the production of night and day. The meetings on Friday, January 8, and on the morning of January 9 were devoted to questions connected with the teaching of languages and art. At the concluding meeting Mr. W. Hibbert described some new forms of apparatus; the most important of these was a magnetic balance devised by him, which has a very long magnetometer needle, and permits the direct estimation of magnetic forces in dynes. Afterwards Prof. Perry, who took the chair, briefly summarised his ideas on the practical teaching of mathematics, and a discussion took place which was introduced by Mr. R. W. Bayliss, of St. Dunstan's College, Catford, who read the paper on practical work in the teaching of geometry. Among the speakers were Mr. Eggar, of Eton, Mr. Garstang, of Bedales, Mr. Harrison, and Mr. Jackson. The general opinion was in favour of making the teaching of geometry practical, but the importance of not forgetting the mental side of the question was emphasised by some speakers.

The geographical exhibition will be shown in other parts of the country, and should prove of very great use to teachers. Individual exhibits which call for attention are the half-inch to a mile reduced survey map of England and Wales without black printing, exhibited by the London School of Economics and issued by Messrs. J. Bartholomew and Co.; the model of the Alps, exhibited by Prof. Dinges; the tinted Siegfried map of Switzerland (one in fifty thousand), brought by Dr. Herbertson to illustrate his remarks, and the excellent maps, geological and topographical, prepared by the Japanese Survey. The number of exhibits officially sent by various Government departments shows the interest taken in the matter. Of the numerous other matters we can only allude to Mr. Freshfield's photographs illustrating types of scenery and to Captain Wilson-Barker's pictures of clouds.

Prof. Tilden, president of the Association of Public School Science Masters, took the chair at the annual meeting held on January 16 at Westminster School, by kind permission of Dr. Gow. The chairman alluded to the influence exerted during the last year upon educational authorities by the Association, and prophesied that its voice would be heard with still greater effect in the future. He pointed out that an attempt was being made to stifle chemistry in the examinations for medicine, and that the exigencies of time prevented engineering students from obtaining the physical knowledge that they ought to have. The solution of the difficulty Prof. Tilden thought would be found in the preparation at school of boys intended for such professions and in their being required to show evidence of the fact before entering upon their special studies.

After the election of Sir Michael Foster as president for the year 1905, and the filling up of vacancies upon the executive committee, the meeting proceeded to discuss the possibility of coordinating the teaching of mathematics and science in public schools. The subject was brought forward by Mr. R. E. Thwaites (Malvern), who pointed out that it would be of the greatest help to public school science if a thorough sympathy and understanding were established between mathematical and science masters. As means to this end it was suggested that practical mensuration should be extended and taught by mathematical men—if possible—in the physics laboratory. Secondly, practical mathematics should be taught to all boys who take theoretical mechanics at present, and this should also be undertaken by the mathematical staff. The fact that mathematical men are regarding the practical bearings of their subject with increased favour was adduced as evidence of the possibility of such hopes being realised. Moreover, the Army Committee has decided that candidates must take a course of practical measurements as part of their mathematics. This can only be carried out properly in the physics laboratory. In view of mathematical men taking laboratory classes a course of practical physics ought to be made obligatory on candidates for honours degrees in mathematics.

Mr. C. S. Jackson (Woolwich), speaking at the beginning of the discussion that followed, said that the reforms should not be put off, as he did not think mathematical men needed a special training, as shown by the introduction of models into their teaching of solid geometry.

Mr. W. D. Eggar (Eton) supported Mr. Thwaites's contentions, and suggested that mathematical masters who went into the laboratory would find no difficulty in keeping a page or two ahead of their boys, while they would learn much of great value to themselves. He condemned the study of electricity and optics, without reference to laboratory work, for university examinations, and, turning to another aspect of public school work, thought that classical masters might help in the pursuit of nature-study.

Mr. W. C. Fletcher (Board of Education) pointed out that the reforms hoped for by his audience he had seen carried out, for in the school at Liverpool of which he was recently head the mathematical masters took their share in the physics teaching, which gave them a fresh interest in their work. He thought that at first the teaching of physics and of mathematics should be in the hands of the same man.

Other speakers on the subject were:—Mr. W. E. Cross (Felsted), Mr. A. W. Siddons (Harrow), Mr. W. A. Shenstone, F.R.S. (Clifton), and Mr. H. Clissold (Clifton).

Mr. M. D. Hill (Eton) started a discussion upon the examination for the Oxford and Cambridge higher certificate. He considered only the position of biology, the teaching of which in public schools would not be encouraged by the examination question, in which its position was unsatisfactory from the point of view of both teacher and pupil. For instance, only one of the six branches could be offered by the candidates, and since practical work is not required, knowledge gained from books rather than from nature would result, and successful papers be written by a candidate who had never seen the objects which he described. He claimed, further, that biology should be placed on an equal footing with other sciences in which public school boys are examined.

Mr. W. A. Shenstone, F.R.S., spoke of the disadvantages of having no practical work in the physics of the same examination. He thought also that the chemistry syllabus was overloaded, and that no line ought to be drawn between organic and inorganic chemistry. Finally, he proposed a resolution to the effect that the opinion of the members of the Association should be taken upon the syllabus, and that the committee, if necessary, should approach the examining board in connection with it. After some discussion the motion was unanimously passed.

The last paper, on "Nature-Study," was read by Mr. O. H. Latter (Charterhouse); he characterised the scope of nature-study as being very wide, and mentioned a host of sciences which, strictly speaking, took cognisance of the material made use of. In fact, he said that nature-study included nearly all visible phenomena. Its object, he continued, is to train the eye to see appreciatively, to awaken interest and to foster certain valuable habits. The matter must be determined by the season of the year and the situation of the school, and an orderly sequence of lessons is not essential. Mr. Latter pointed out how useful the knowledge obtained may be made when English composition is being undertaken. The boy in ordinary cases is gravelled for lack of matter, but when he has observed for himself he is able to put down what he has learned in a way that is interesting and shows individuality. Though he made no attack upon physics and chemistry, which had their own and necessary uses in education, Mr. Latter said that in many respects nature-study is superior to them, especially for young children, and the training which it affords is different in kind. The habits acquired are of value in all walks of life, but they would be especially so in a military service, and Mr. Latter much regretted that what he terms "field subjects" were entirely absent from army examinations. Nature-study, in Mr. Latter's opinion, has come to stay, and will, before long, take a regular place in the early stages of our education. One of the greatest faults of our school system is that the desire for knowledge on the part of the child—who is by nature both inquisitive and observant—is killed outright in most cases by the time that the age of seventeen is reached. It was suggested that nature-study might profitably be employed in the two or three lowest forms of our public schools, but as it is of specially great importance in preparatory schools, Mr. Latter thought that the Association should approach the preparatory school masters with a view to obtaining some uniformity of action on their part. The matter is particularly urgent, as a combined examination for entrance

to a number of public schools is likely to be devised in the future. In conclusion, Mr. Latter was of opinion that nature-study might with advantage be extended to advanced biological work of the school and university laboratories.

A discussion followed, in which the chairman, Mr. Hill, Mr. Shenstone, Mr. Talbot and others took part. Prof. Armstrong said that the phrase "nature-study" was simply a "war cry" at present, and was being used by one party for something which was scientific neither in its intentions nor methods. Later on in the discussion the facts were mentioned that nature-study has a general educational significance, and is recognised in England as expressing the methods of science, but as being otherwise of an informal character.

In reply, Mr. Latter said that all he wanted was that the boys should have their eyes opened, and a resolution was passed that a subcommittee should be appointed to communicate with the preparatory schools in order to determine the form of science teaching best suited to their needs.

WILFRED MARK WEBB.

THE ORIGIN OF THE AUSTRALIAN MARSUPIALS.

THE relationships of marsupials in general to other mammals, the route by which their Australasian representatives reached their present habitat, and the date of their arrival, are problems which have of late years attracted a large amount of attention on the part of naturalists, and are still far from being definitely solved. A bold and vigorous attempt to determine these questions has lately been made by a promising young Canadian zoologist, Dr. B. A. Bensley, of Toronto University, who a few years ago paid a visit to England for the purpose of studying the unrivalled amount of material in the British Museum. The final results of his investigations have just been published in the *Transactions* of the Linnean Society of London. Needless to say, this elaborate memoir is bristling with technicalities, and much of its contents is of far too abstruse a nature to be even touched upon in a journal like our own. Nevertheless, there are certain parts of more general interest which admit of notice.

One of the difficulties which beset the study of the group has arisen from the discovery, by an Australian naturalist, that the bandicoots, unlike other marsupials, possess vestiges of a placenta, by means of which the maternal blood is brought into direct connection with that of the fœtus, and the question is whether this implies a much nearer relationship between marsupials and ordinary placental mammals than has been generally supposed to exist. Dr. Bensley answers the question in the negative, believing the bandicoot placenta to have had an independent origin. He may, of course, be right in this surmise, but it must always be remembered, as in analogous cases, that this is a summary, if convenient, way of getting rid of difficulties. Even, however, on this view, the author is of opinion that the relationship between marsupials and placentals is much more intimate than was believed to be the case by the older naturalists.

As the result of the investigations of several modern naturalists, the belief is gradually gaining ground that all the modern marsupials, with the possible exception of the Tasmanian wolf, or thylacine, are derived from a primitive arboreal type, of which the South American opossums (not the animals so miscalled in Australia) are now the only representatives. This arboreal ancestry is chiefly displayed in the structure of the foot, and even the essentially terrestrial kangaroos can be easily traced, through the phalangers (the miscalled opossums of Australia), into connection with an arboreal type. Somewhat curiously, it may be mentioned in passing, certain members of the former group—to wit, the tree-kangaroos—show a kind of reversion to the arboreal life of their ancestors. There are, however (as, indeed, would be manifestly impossible), no signs of reversion to the original grasping type of foot, tree-kangaroos hopping on the larger branches in the characteristic manner.

The opossums, then, are the most primitive of living marsupials, and since they date from the earlier portion (Eocene) of the Tertiary period, they are likewise the earliest animals which can be definitely included in that group, for there is great doubt whether any of the small mammals of the Secondary epoch (those, for instance, of the Stonesfield slate and Purbeck beds) are really marsupials, or at all events marsupials as we now know them.

The arboreal "radiation" (to use a term now extensively employed by American zoologists) of marsupials differentiates them from the extinct creodonts, or primitive Carnivora, of the early Tertiary epoch, which appear to have been essentially terrestrial types. Nevertheless, by means of certain Middle Tertiary South American forms (the so-called sparassodonts), these same creodonts appear to have been very closely connected with the thylacine, and thus with other marsupials, and this presumed relationship seems to have considerably puzzled Dr. Bensley. For, while including that animal in the Dasyuridæ, he suggests that it may be an altogether foreign member of the Australian fauna, and that its origin may have to be sought elsewhere—presumably in South America. He adds that no signs of arboreal ancestry are to be detected in the thylacine's foot. If this means anything, it seems to imply that the animal in question is not related at all to the typical arboreal marsupials, but that its kinship (unless the resemblances are due to "parallelism in development") is with the South American sparassodonts, and thus with the creodonts. But if so, it surely seems to follow that the creature is not, phylogenetically, a marsupial at all. The whole question seems a hopeless puzzle, and if the author cannot explain it, most surely we will not make the attempt.

To turn to less debatable ground, great interest attaches to the author's remarks concerning the huge extinct marsupial from Australia described by Owen as a carnivore, under the name of Thylacoleo. Arguing from the resemblance of its dentition to that of the phalangers, later writers, however, came to the conclusion that the creature was herbivorous. This view is discredited by Dr. Bensley, who, following Dr. Broom, reverts to the opinion that it was a flesh-eater, which, as Owen suggested, may have preyed on the contemporary giant kangaroos or even the still more gigantic diprotodons. Nevertheless, it is believed that Thylacoleo was descended from herbivorous marsupials allied to the phalangers, and, this being so, it is not easy to see why the author assigns it to a family group by itself. This, however, is but a detail.

The marsupials of Australasia, it is pointed out, must have come either from the north-west by way of the Malay Archipelago and Papua, or from the south through an Antarctic connection. Certain objections raised by Prof. Baldwin Spencer against a Malayo-Papuan route are discounted, but the author does not commit himself to any definite opinion as to the probable line of immigration.

As to the date of the immigration, the author, after mentioning that one authority makes it Jurassic, a second Cretaceous, and a third Eocene, inclines to the opinion that it did not take place until the Miocene or middle division of Tertiary time. Although we incline to the view that it was probably Tertiary, so late an epoch as the Miocene seems to allow a very short period for the evolution of the numerous modern forms and their immediate ancestors.

Later on, it is argued that opossums may be the descendants of Jurassic ancestors, or they may themselves be the original marsupials. Assuming the latter to be the case, it may be asked, was the arboreal marsupial radiation only Tertiary, and are creodonts (inclusive of the South American sparassodonts) and the thylacine developments of an earlier common terrestrial stock related to the still earlier mammal-like reptiles?

Summing up the evidence as to the diffusion of modern marsupials, the author is of opinion that during the Oligocene period there was a radiation of opossums throughout a large portion of the northern hemisphere, and that some of these animals gained an entry into South America, where they may have given rise to the extinct Microbiotheriidæ of Patagonia. Then came the immigration into Australasia, during Miocene or Middle Tertiary time. About the same period occurred the great development of South American marsupials, such as the extinct Abderitidæ and the forerunners (Epanorthidæ) of the modern

Cœnolestes. The sparassodonts (Prothylacinidæ) are also included in this radiation, although how these terrestrial types (which, as already stated, the author thinks were probably allied to the thylacine) were developed from arboreal forms is left unexplained. Finally, in the Pliocene occurred the irruption into South America of the modern opossums of that country.

It may be added that the author classifies modern marsupials by the foot-structure rather than by the dentition, thus making the two main groups Didactyla and Syndactyla, in place of Polyprotodontia and Diprotodontia.

R. L.

CONTRIBUTIONS TO THE SCIENCE OF MEDICINE.[1]

THE handsome volume under notice contains a number of important papers of considerable interest to the physiologist, pathologist, and physician. It commences with a description, and an account of the opening, of the Johnston Laboratories for Biochemistry, Tropical, and Experimental Medicine, the munificent gift of Mr. William Johnston—hence the addition in the title of these reports. This has a melancholy interest also, since one of those who replied to the toasts on that occasion was the late Prof. Nocard.

The first paper is by Prof. Moore on the synthesis of fats accompanying intestinal absorption, in which it is shown that absorbed fat is re-synthesised to neutral fat in the intestinal mucous membrane. Neurology is represented by papers on the physiology of the cerebral cortex in anthropoid apes, by Dr. A. S. Grünbaum and Prof. Sherrington (reprinted from the *Proceedings* of the Royal Society, London), and on the electric conductivity of mammalian nerve, by Dr. Woodworth. Prof. Sherrington records a number of experiments carried out for the special chloroform committee of the British Medical Association on the dosage of the mammalian heart by chloroform; these have already been referred to in the columns of NATURE. Dr. Hume publishes a method for the isolation of the typhoid bacillus, based upon the greater motility of this organism compared with that of the colon bacillus, with which it is generally associated, so that the former will reach the surface of a column of viscid medium sooner than the latter when the two are introduced at the bottom. Mr. Roaf contributes a note on the influences of flour and allied substances upon the typhoid bacillus, from which it would seem that emulsions of flour are inhibitory to the growth of this microbe. Dr. J. W. Stephens describes a modification of the Van Ermengem method for flagella staining.

The study of cancer is represented by two important papers, one by Dr. Prowse on the relation of vesicular mole to chorion carcinoma, the other by Mr. Keith Monsarrat on an organism associated with mammary carcinoma. In the last-named it is claimed that by the use of a special culture medium, round encapsuled organisms have been cultivated, the cultures in certain instances producing nodules of growth when inoculated into guinea-pigs.

The vitality of the Liverpool School of Tropical Medicine is evidenced by several contributions. Prof. Ronald Ross describes his "thick film" process for the detection of malaria and other parasites in blood. Dr. Christy and Dr. Stephens contribute papers on "tick fever" and on "blackwater fever" respectively, and Drs. Stephens and Christophers give a summary of researches on native malaria and blackwater fever, and suggestions for the prevention of these dread scourges.

Finally, the volume concludes with the report of the malaria expedition to the Gambia in 1902, by Mr. Dutton, to which an appendix is contributed by Mr. Theobald on the mosquitoes collected in that expedition, with a description of some new species. Every paper contains the results of original work or observations of value, and the general "get up" of the volume is all that could be desired, the illustrations being numerous and excellent.

R. T. HEWLETT.

[1] "The Thompson-Yates and Johnston Laboratories Reports." Vol. v. (New Series.) Part I. (London: Longmans, Green and Co., 1903.)

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—It is proposed to "affiliate" the University of King's College, Nova Scotia. Graduates in arts of that university will be admitted to the privileges of affiliated students, namely, exemption from the previous examination and permission to proceed to the B.A. degree after six terms' residence in Cambridge.

An annual prize in civil engineering, of the value of about 15*l*., has been founded by Mrs. Wimbolt, in memory of her late husband, Mr. J. S. Wimbolt, M.A., of Trinity College. The prize is open to Bachelors of Arts, and will be given for the best exercise or dissertation embodying the results of independent research in some subject related to the profession of a civil engineer.

THE Finance Committee of the Liverpool Corporation has decided to recommend the city council to grant to the Liverpool University 10,000*l*. during the year 1904, such sum to be paid out of the city rate.

AT the Northampton Institute, Clerkenwell, on Friday, February 26, Lord Kelvin will present the certificates and prizes on the occasion of the annual prize distribution and conversazione of members and students.

A CONFERENCE on nature-study, arranged by the School Nature Study Union, will be held on Saturday, January 30, at the Passmore Edwards' Settlement, Tavistock Place, W.C. The chair will be taken by Mr. Cyril Jackson, Chief Inspector, Board of Education, and two short papers will be read by representatives of elementary and secondary schools.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, December 10, 1903.—"On the Resemblances Exhibited between the Cells of Malignant Growths in Man and those of Normal Reproductive Tissues." By J. Bretland **Farmer**, J. E. S. **Moore**, and C. E. **Walker**.

The object of the communication is to direct attention to certain important cytological transformations exhibited during the development of malignant growths in man. The changes described appear to be diagnostic of malignant as opposed to benign growths, inasmuch as they seem to be absent from the latter class of tumours. Briefly, the authors have identified, within the proliferating edges of advancing growths, cells that exhibit a type of karyokinesis presenting an extraordinary similarity to, if not identity with, the heterotype mitosis that forms so constant a character during the production of sexual cells. This mitosis, or nuclear division, is remarkably different in character from the other divisions in the body-cells, and is recognised with ease and certainty. The nuclear chromosomes pass through a totally different series of changes as compared with those exhibited by the chromosomes of ordinary nuclei. Not only in shape is this difference manifested, but also in the reduction of their number to one-half; and in all the subsequent cell generations that follow from a cell that has once passed through the heterotype mitosis the reduced number of chromosomes is retained in normal cases that lead to the direct formation of the sexual cells themselves. In any cells, otherwise of similar (heterotype) origin, that are not about to form actual sexual cells, variations and abnormalities may supervene.

All the principal varieties that are commonly met with during the evolution of the sexual cells have been identified in malignant growths of carcinomatous and sarcomatous types. The authors consider themselves justified in relating the malignancy of the growth with these facts, and they regard the malignant tissue in question as having originated in cells that have lost their somatic character, and have directly assumed the nature of reproductive tissues.

They propose the term *gametogenic* to signify tissues that are potentially or actually about to give rise to sexual cells (gametes), whilst they call the cells that have passed through the metamorphoses indicated above, but which do not finally form functional gametes, *gametoid*. This expression is thus intended to embody their conclusion that the

so-called "cancer cells" are not, indeed, functional gametes, but essentially of a similar character.

They point out that the origin of gametogenic cells from somatic tissue is a common feature in plants, but its occurrence is obscured in animals because it involves a pathological condition. They further point out that parasitic habit of the neoplasm finds its analogue in the normally parasitic character of the gametogenic tissue of plants.

Linnean Society, December 17, 1903.—Prof. S. H. Vines, F.R.S., president, in the chair.—The Rev. T. R. R. **Stebbing**, F.R.S., exhibited :—(1) A house-spider (Tegenaria sp.) with its cylindrical dwelling in the coiled feather of an Indian fan. The fan which the spider adapted to its purposes had been hanging up in a drawing-room at Jerusalem. The spider, forwarded by Miss FitzJohn to Miss Grace Stebbing, reached England alive. (2) A solid gnaur or excrescence upon the root of *Cupressus macrocarpa*, sent for exhibition by Mr. F. G. Smart, of Tunbridge Wells; it was eleven inches in circumference.—On the Docoglossa; an evolutionary study : H. J. **Fleure.** The Docoglossa are a division of gastropod molluscs for which the stout teeth on the lingual ribbon have suggested a name literally meaning "beam-tongued." The common limpet is a sufficiently familiar representative of this group. Mr. Fleure's essay aims at showing that the group, within the limits which he defines, is a natural one. To arrive at the structure of the common ancestor, he uses "the facts of comparative anatomy and the few known details of palæontology and embryology for the reconstruction of docoglossan history." Admitting the preliminary character of this evolutionary study, based on the examination of comparatively few types, he appeals to zoologists for further material on which he may extend his researches.—A brief account of new researches in cancer : Prof. J. Bretland **Farmer,** F.R.S. The author referred to current theories of cancerous growth, and then proceeded to state his own discovery that the cytological changes in malignant growth resemble those exhibited by sporogenous or gametogenous tissues in plants and animals, in the occurrence of the form of nuclear division known as heterotype, as distinguished from the more usual homotype division.

Royal Astronomical Society, January 8.—Prof. H. H. Turner, president, in the chair.—Mr. **Conrady** read a paper on the chromatic correction of object glasses.—Mr. Wm. **Ellis** read a paper on auroras and magnetic disturbances.—Mr. Maunder read a paper by Mrs. **Maunder** on a suggested connection between sun-spot activity and the secular change in magnetic declination.—Mr. **Maunder** also read a paper by himself (communicated by the Astronomer Royal) on the "great" magnetic storms from 1875 to 1903, and their association with sun-spots, as recorded at the Royal Observatory, Greenwich. The data given in the paper showed a remarkable number of coincidences between the appearance of large spot groups and the occurrence of the greater disturbances in terrestrial magnetism.—Prof. **Turner** gave an account of the observations of variable stars made under the direction of the late Sir C. Peek at Rousdon Observatory, Lyme Regis. Prof. Turner had undertaken to edit and discuss the observations, which would be shortly published in the *Memoirs* of the Society.—Mr. Tyson **Crawford** showed a new finder eyepiece and a sketching board arrangement for the telescope.—Mr. **Wesley** read a note on Mr. Ritchey's photographs of the nebula in Andromeda. The transparency which Mr. Ritchey had sent to the Society had been taken from a negative in which the dense central portion had been reduced with a weak reducing solution, so as to show on the same photograph the details both in the dense central and the faint outlying parts of the nebula. Mr. Wesley had carefully compared this transparency with some *untouched* negatives which Mr. Ritchey had since sent, and concluded that the local reduction had produced no false detail or spurious effects.—Mr. Hinks showed photographs of the Orion nebula by Mr. W. E. **Wilson,** in which the detail in the central portion had been brought out by differential printing, instead of reduction of the negative.

EDINBURGH.

Royal Society, December 7, 1903.—Dr. Robert Munro, vice-president, in the chair.—The Keith prize for 1899–1901 was presented to Dr. Hugh Marshall for his discovery of the persulphates and for his communications on the properties and reactions of these salts, published in the *Proceedings* of the Society. The Makdougall-Brisbane prize for 1900–1902 was presented to Dr. Arthur T. Masterman for his paper entitled "The Early Development of *Cribella Oculata* (Forbes), with Remarks on Echinoderm Development," printed in vol. xl. of the *Transactions* of the Society.—In a paper on the bull trout of the Tay and of the Tweed, Mr. W. L. **Calderwood** discussed the identification of this important migratory species, and gave reasons for the view that the Tay bull trout was a true salmon, which has undergone modification of probably a temporary nature, while the Tweed fish was a trout regarded as the proper representative of *S. criox*, now classed as a variety of *S. trutta*.—Mr. J. G. **Goodchild** read a paper entitled "Field Evidence Relating to the Modes of Occurrence of Intrusive Rocks," in which he gave a detailed description of a number of cases in which intrusive rocks had clearly replaced their own volume of the rocks they invade. Hughes in 1868, and Clough in 1880, had indicated cases of this kind, and had considered that the country rock so replaced had been dissolved, and that the composition of the product had been equalised by circulation. Mr. Goodchild supported this view, and gave an outline of what appeared to be the *modus operandi*. The chief factors concerned were :—(1) the heat generated by dynamic causes, connected chiefly with terrestrial disturbance; (2) the presence of saline constituents existing in solution in sea-water or in the inland lakes of arid regions, which found their way to the foci of volcanoes and there underwent concentration by prolonged boiling; and (3) the influence of pressure arising partly from the generation of steam and partly from the dynamic causes to which the volcanic heat was mainly due. He concluded with some remarks upon the differentiation of the magma originating in this way, and the possible effects which might arise from a potash magma invading an older set of rocks which had consolidated from an earlier soda magma.

December 21, 1903.—Prof. Flint, vice-president, in the chair.—Prof. **Schäfer** read a paper on the relative efficiency of certain methods of performing artificial respiration in man. After describing the apparatus he had devised for the accurate measurement of the air inspired and expired per minute, he proceeded to compare the various methods associated with the names of Sylvester, Howard, and Marshall Hall, and showed by actual numbers that these all fell short of the natural breathing, the least efficient being Sylvester's, in which the chest is expanded and contracted by motion of the arms. This method, which was still in common use for resuscitation from drowning, was absolutely condemned. The Howard method was moderately efficient, and was most in favour among medical men. The Marshall Hall method was somewhat less efficient than the Howard, and had the further objection of being more complicated. More efficient than any of these, and remarkably easy to perform, was the "Schäfer" method, in which the subject was placed in the prone position and an intermittent pressure applied on the lower ribs by the mere weight of the operator's body, which was swung backwards and forwards some thirteen times a minute. By this method 6760 cubic centimetres per minute were forced through the lungs as against 5850 cubic centimetres which passed in natural breathing.—Dr. C. E. **Fawsitt** gave an account of certain physicochemical investigations in the amide group. From determinations of the change of conductivity produced by the addition of an amide to acid, alkali, and neutral salts, he concluded that the amides have no acid character, but only basic properties. Accordingly, the amide group is better represented by the formula

$$\begin{array}{c} \mathrm{O} \\ \| \\ -\mathrm{C}-\mathrm{NH} \end{array} \quad \text{than by the formula} \quad \begin{array}{c} -\mathrm{C}{=}\mathrm{NH} \\ | \\ \mathrm{O}-\mathrm{H} \end{array}.$$

The change of conductivity produced by the addition of an amide to a neutral salt is a viscosity effect. The viscosity of solution of acetamide and carbamide follows very closely the formula $y_a = A^a$, where y is the viscosity with concentration a, and A is a constant.—In connection with Sir John Murray's bathymetrical survey of the Scottish fresh-water lochs, Mr. James **Murray** gave a preliminary note on the biology of

Loch Ness. The organisms found were grouped under the three headings, pelagic, littoral, and abyssal. All the pelagic forms and most of the abyssal forms extended into the littoral region, but the littoral forms (which were by far the most numerous) were rarely found in the open waters. A comparison of the organisms found in spring and in autumn showed that there was little seasonal variation, the chief difference being the greater number of Rotifers in autumn and the presence of certain species of Cladocera in the later season. A remarkable vertical migration of Leptodora was established, the animal coming to the surface in great numbers immediately after sunset, and retiring to a depth of 100 feet or more during the day. The study of the animals obtained from the deep muds had led to many interesting results. The Rotifers in the abyssal region differed from specimens got nearer shore, but not enough to lead to their classification as distinct species. One main difference was in the size of the eyes.

Dublin.

Royal Dublin Society, December 15, 1903.—Prof. W. F. Barrett, F.R.S., in the chair.—Prof. T. **Johnson** read a paper on willow canker. The author gave an illustrated account of an osier canker due to *Physalospora gregaria*, Sacc., a hyalosporous sphaeriaceous Pyrenomycete, which is recorded in "Sylloge Fungorum," on Prunus, Salix, Alnus, Rosa, &c., in Italy, France, Siberia, and South America. The ascosporous stage is associated in the cankers with two others—pycnidia with triseptate conidia, and pycnidia with bisporous intercalary conidia on branching hyphae. Economically the fungus does great harm, killing many of the osier sets outright, and in other cases spoiling the rods for basket-work. The author has traced the fungus from the sets first planted with the rods cut from year to year, and has also found the disease to be present in the osier holt in England from which the original sets were supplied. Experiments in infection and in prevention were also described.—Dr. Henry H. **Dixon** and Dr. J. T. **Wigham** presented a paper on the action of the radiations from radium bromide on some organisms.

Paris.

Academy of Sciences, January 11.—M. Mascart in the chair.—The action of the X-rays upon animal tissues: R. **Lépine** and M. **Boulud.** The X-rays favour the formation of amylase in the pancreas. In the liver and in the blood, their first action is to increase glycolysis, but this effect is diminished, or even arrested, by their prolonged action.—M. Lacroix was elected a member in the section of mineralogy in the place of the late M. Munier-Chalmas.—On the asymptotic study of meromorphic functions: M. Émile **Borel.**—On the homographic resolution of spherical triangles: M. **d'Ocagne.**—On the properties of notched test-pieces: Aug. **Pourcel.**—On a self-recording apparatus allowing of the measurement through a solid wall, carrying pressures relatively high, of small differences of pressure: M. A. **Mesnager.**—On a method for the comparison of thicknesses: M. **Mesnager.** In the method of MM. Pérot and Fabry a thin layer of air between two half-silvered glass plates making a small angle with each other is utilised. The delicacy of the measurements is increased two hundred times by replacing the air film by a thin plate of quartz. The quartz plate, placed between two parallel Nicols, gives the same fringes as the half-silvered plates, but 218 times larger. This arrangement also possesses the advantage of absorbing much less light than the compensator with half-silvered plates, and also avoids the confusion resulting from multiple reflections.—On the production of the *n*-rays by sound vibrations: J. Macé **de Lépinay.** The fact that the compression or extension of a body gives rise to the *n*-rays led to the conclusion that sound vibrations would produce the same effects, and this conclusion has been experimentally confirmed.—On the applications of the chronostiliscope: E. **Varenne** and L. **Godefroy.**—Colour reactions of vanadic acid and ethenol: Camille **Matignon.** The colour reaction obtained with vanadic acid and some specimens of ordinary ether has been traced to the presence of ethenol, vinyl alcohol.—The use of bismuth as a separating agent for the rare earths: G. **Urbain** and H. **Lacombe.** On adding to uncrystallisable mother liquors of the rare earths their own weight of the double nitrate of magnesium and bismuth, the latter carries down the gadolinium in crystallising, the operation being repeated until the soluble earths no longer give the spectrum of gadolinium. This method of extraction works equally well in the elimination of gadolinium from crude yttrium earths.—A new method of estimating the halogens in organic compounds. The case of chlorine and bromine: A. **Baubigny** and G. **Chavanne.** The compound is oxidised by heating with a mixture of sulphuric and chromic acids, the halogen being caught in an alkaline sulphite solution. Analytical results are given showing the accuracy of the method.—The titration of manganese: Léon **Déhourdeaux.** The oxide is dissolved in a solution of sulphuric and oxalic acids, the active oxygen being measured by the amount of oxalic acid destroyed, and from the amount of sulphuric acid used up the quantity of hydrochloric acid required by the oxide in the commercial preparation of chlorine can be calculated.—On a new general method for the synthesis of aldehydes: MM. **Béhal** and **Sommelet.** Aldehydes of the types $R_2.CH.CH{=}O$ and $RR'.CHCH:O$ are obtained by heating α-glycols of the type $RR'.C(OH).CH_2.OX$ with oxalic acid. The glycols are readily obtained by Grignard's reaction from the ketones $R.CO.CH_2.OC_2H_5$. The properties of a series of aldehydes prepared by this method are given, in which R includes alkyls from methyl to isoamyl, and also allyl and phenyl. The method appears to be quite general.—The synthesis of aromatic aldehydes: F. **Bodroux.** Phenylmagnesium-bromide reacts with ethyl orthoformate and gives benzaldehyde, with a yield of 90 per cent. The para-tolyl magnesium bromide reacts in a similar manner.—The stimulating influence of an albumenoid material on the oxidation caused by manganese salts: A. **Trillat.** The oxidising effect is increased by the addition of an albumenoid, but the effect produced is not proportional to the amount of the latter, there being a proportion producing a maximum result.—On the formation of tetrads and maturative divisions in the testicle of the lobster: Alphonse **Labbé.**—On the nidamental gland of the oviduct in elasmobranchs: I. **Borcea.**—The emission of *n*-rays by plants: Édouard **Meyer.** *N*-rays are emitted by plants, this emission being a function of the nutritive activity or evolution of the plant.—The morphological characters of the Acrocecidia: C. **Houard.**—Chronology of the cave near Mentone: Marcellin **Boule.** A further examination of these well-known caves has been undertaken at the instigation of the Prince of Monaco, and has resulted in the discovery of four human skeletons, many fossil remains of animals, and a large number of worked objects in stone and bone. The present paper contains the results of the stratigraphical study of these caves. Layers have been found corresponding to the Upper and Lower Quaternary, and a layer beneath these which appears to be pre-Quaternary.—On the earthquakes in the Andes: de Montessus **de Ballore.**—On the general bathymetric chart of the ocean: J. **Thoulet** and Ch. **Sauerwein.**—An experimental demonstration of the general action of the interstitial gland of the testicle on the economy: P. **Bouin** and P. **Ancel.** Contrary to the opinion of Brown-Séquard, the seminal fluid is without action on the organism, the interstitial gland alone possessing the functions generally recognised as belonging to the whole testicle.—Cooperation, hierarchisation, and integration of the sensations in the Artizoa: Georges **Bohn.**—Radiotherapy as a means of diagnosis and therapeutics in certain fibromas: Foveau **de Courmelle.**

New South Wales.

Royal Society, October 7, 1903.—Mr. F. B. Guthrie, president, in the chair.—The geology of the Mittagong district: T. Griffith **Taylor** and D. **Mawson.** The authors show in this paper that the eruptive rocks of the Mittagong district are all of post-Triassic age.—Notes on some native dialects of Victoria: R. H. **Mathews.**

November 4, 1903.—Mr. F. B. Guthrie, president, in the chair.—On some further observations on the life-history of *Filaria immitis*, Leidy: T. L. **Bancroft.** In this paper Dr. Bancroft (who has at various times during the past fifteen years worked at filarial diseases of the human subject, the dog, and birds) has detailed the results of final work on this subject. He has succeeded, through the agency of mosquitoes, in transmitting *Filaria immitis* from

an infected to several healthy dogs, and has also observed the manner in which the young Filaria leaves the mosquito's proboscis.

Linnean Society, November 25, 1903.—Mr. Henry Deane, vice-president, in the chair.—Sur quelques Similitudes des Langues et des Coutumes des Indigènes de Funafuti (Ellice Group) et des Indigènes des Iles de la Société, de l'Archipel des Tuamotu, &c., by MM. **Donat** and **Seurat**. The resemblances specially considered have reference to the names of divinities, temples, the cocoanut, *Morinda citrifolia* and the root of Cordyline; the bark girdle ornamented with feathers, and the eye-shade; the hooks and baits used in fishing, and the capture of turtles; edible Mollusca; and juvenile games.—The variability of Eucalyptus under cultivation, by Mr. J. H. **Maiden**. The author has been at considerable pains to obtain specimens of the Eucalypts described as new species from cultivated forms. Through the kindness of the professors of the Museum d'Histoire Naturelle at Paris, he has obtained a large number of Naudin's types, and has expressed his views as to the identity of these with spontaneous Australian forms.—Notes from the Botanic Gardens, Sydney, No. 9, by Messrs. J. H. **Maiden** and E. **Betche**. This paper continues the series of descriptions of new Australian plants, new records for New South Wales, and critical notes of special interest to Australian botanists.—On the botany of the "clears" and "basalt masses," County of Hunter, N.S.W., by Mr. A. C. **Barwick**.—Description of a new genus and species of Coleoptera (Fam. Hispidæ) from New Britain, by Mr. David **Sharp**, F.R.S. The generic name Brontispa, n.gen. Chrysomelidarum (Hispides, group Cryptonychides), is proposed for this insect, which has of late done much damage in cocoanut plantations.

DIARY OF SOCIETIES.

THURSDAY, JANUARY 21.

ROYAL SOCIETY, at 4.30.—On the Acoustic Shadow of a Sphere, with an Appendix by Prof. A. Lodge giving the Values of Legendre's Functions from P_0 to P_{20} at Intervals of 5 Degrees: Lord Rayleigh, O.M., F.R.S.—The Third Elliptic Integral: Prof. A. G. Greenhill, F.R.S.—On the Structure of the Palæozoic Seed *Lagenostoma Lomaxi*, with a Statement of the Evidence upon which it is referred to Lyginodendron: Prof. F. W. Oliver and Dr. D. H. Scott, F.R.S.—The Significance of the Zoological Distribution, the Nature of the Mitoses, and the Transmissibility of Cancer: Dr. E. F. Bashford and J. A. Murray.—In view of the special meeting immediately following, these papers will be taken as read by printed abstract.

ROYAL INSTITUTION, at 5.—The Flora of the Ocean: G. R. M. Murray, F.R.S.

LINNEAN SOCIETY, at 8.—An Account of a Plankton Expedition to the Bay of Biscay in H.M.S. *Research* in 1900: Dr. H. G. Fowler.—The Crustacea obtained by Dr. G. H. Fowler in the Biscayan Plankton: Rev. T. R. R. Stebbing, F.R.S.

FRIDAY, JANUARY 22.

ROYAL INSTITUTION, at 9.—Spectroscopic Studies of Astrophysical Problems at Stonyhurst College Observatory: Rev. Walter Sidgreaves, S.J.

PHYSICAL SOCIETY, at 5.—The Photographic Action of Radium Rays: S. Skinner.—Astigmatic Aberration: W. Bennett.—Some New Cases of Interference and Diffraction: Prof. R. W. Wood.—Exhibition of Instruments by Messrs. Crompton and Co.

SATURDAY, JANUARY 23.

ROYAL INSTITUTION, at 3.—British Folk Song: J. A. Fuller-Maitland.

MATHEMATICAL ASSOCIATION, at 2.—Annual Meeting.—Models of Regular and Semi-regular Solids, including the four "polyèdres étoilés" of Poinsot, exhibited by Mr. E. M. Langley.—An Account of a Recent Discussion on the Possibility of Fusion of the Teaching of Mathematics and Science: C. S. Jackson.—A Geometrical Note: J. C. Palmer.—Advanced School Courses of Mathematics: C. A. Rumsey.

MONDAY, JANUARY 25.

SOCIETY OF ARTS, at 8.—Oils and Fats—their Uses and Applications: Dr. J. Lewkowitsch (Cantor Lectures I.).

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—The Geographical Pivot of History: H. J. Mackinder.

INSTITUTE OF ACTUARIES, at 5.—A Comparison of the Various Methods of Grouping Whole-Life Assurances for Valuation: D. C. Fraser.

TUESDAY, JANUARY 26.

ROYAL INSTITUTION, at 5.—The Development of Animals: Prof. L. C. Miall, F.R.S.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Sanding-up of Tidal Harbours: A. E. Carey.

WEDNESDAY, JANUARY 27.

SOCIETY OF ARTS, at 8.—Ice-Breakers and their Services: Arthur Gulston.

THURSDAY, JANUARY 28.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: Observations on the Sex of Mice—Preliminary Paper: Dr. S. Monckton Copeman, F.R.S., and F. G. Parsons.—Observations upon the Acquirement of Secondary Sexual Characters indicating the Formation of an Internal Secretion by the Testicle: S. G. Shattock and C. G. Seligmann.—On the Part played by Benzene in Poisoning by Coal Gas: Dr. R. Staehelin.—The Morphology of the Retrocalcarine Region of the Cortex Cerebri: Prof. G. Elliot Smith.

ROYAL INSTITUTION, at 5.—The Flora of the Ocean: G. R. M. Murray, F.R.S.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—The Edison Accumulator for Automobiles: W. Hibbert. (Adjourned discussion.) To be opened by Dr. J. A. Fleming, F.R.S.—On the Magnetic Dispersion in Induction Motors, and its Influence on the Design of these Machines: Dr. H. Behn-Eschenburg. (Adjourned discussion.)

FRIDAY, JANUARY 29.

ROYAL INSTITUTION, at 9.—The Marshes of the Nile Delta: D. G. Hogarth.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Metallurgy as Applied in Engineering: Archibald B. Head.

SATURDAY, JANUARY 30.

ROYAL INSTITUTION, at 3.—British Folk Song: J. A. Fuller-Maitland.

CONTENTS.

THURSDAY, JANUARY 28, 1904.

PROF. ARMSTRONG'S EDUCATIONAL CAMPAIGN.

The Teaching of Scientific Method and other Papers on Education. By Henry E. Armstrong, LL.D., Ph.D., F.R.S. Pp. x+476. (London: Macmillan and Co., Ltd., 1903.) Price 6s.

THIS book reproduces the chief contributions which Prof. Armstrong has made to the literature of education from 1884 to the present time, with the addition of a parody by another hand of that most parodied of music hall lyrics, "The Absent Minded Beggar." I have been so constantly in touch with Prof. Armstrong, and occasionally so closely associated with him, that the book comes to me in no degree as a new work, and I have perforce read it from the point of view of one who regards the mode of presentation of the case rather than the merits of the case itself. Though the work is entitled "The Teaching of Scientific Method," its scope is much wider, for it is an indictment of our educational system from top to bottom, and an indication of how education is to be set right in its relation to all the arts of peace and war.

It appears to me that the weakness of Prof. Armstrong's book lies in the want of system and coordination. The arrangement is probably as good as it could be, provided that nothing were feasible but the mere reprinting of twenty-three occasional addresses, but it is impossible not to suppose that the constant reiteration of doctrine, and the continual reappearance of almost the same words, will deter a reader who sits down to read the book solidly through. It would have been a considerable labour, but it would have given unity and plan to the book, if Prof. Armstrong had mixed the twenty-three outpourings, and had subjected the mixed liquid to a process of fractional distillation.

Coming to the matter of the book, it is unnecessary in the pages of NATURE to say a single word in justification of Prof. Armstrong's assertion of the importance of science as an element in national education, and of the importance of teaching science well. I shall confine myself, therefore, to the question as to whether the method of teaching science which Prof. Armstrong advocates is really a way of teaching it well. On this question there is an apparent diversity of opinion among those who may be supposed to be entitled to express an opinion. I will assume no editorial plural in writing on the subject. I, as one teacher, after twenty years' constant study and observation of science teaching in schools am of opinion that Prof. Armstrong is advocating what is essentially a good method, and though I know that this same method has been spoken of by distinguished people in terms of condemnation and ridicule, I am ready to justify my opinion.

The objects of science teaching in schools have been stated again and again in all degrees of fulness and eloquence. They appear different to different people. Science gained a footing in the schools of this country, I think, in the hope that it would prove a bread-and-butter study, and would provide a body of useful information as clearly available for practical purposes as arithmetic. It was an important ingredient of that "modern side" education which was the outcome of a rebellion against the classical basis on which all education had previously rested. It was accepted reluctantly by schoolmasters, who, too ignorant of science to understand its higher possibilities, regarded the intrusion as essentially Philistine in origin and in aim.

In France science was introduced into the school curriculum with a totally different object. The aim there was to add an element of natural philosophy, to open the mind of the young to an appreciation of the grandeur of natural laws, to use science as an element of culture.

My own independent critical knowledge of science teaching in schools does not go back more than twenty years, but I am prepared to maintain that twenty years ago the science teaching that prevailed in this country was in the main execrable. Good teachers there were, no doubt, for good teachers there always will be, independently of all systems. But whether looked at as giving useful information, culture, or mental training, the teaching of science in my school days and after was in the main worthy of the contempt with which it was regarded by all those who had a humane interest in education.

This state of things has now been altered to a degree which makes the change one of the most remarkable and gratifying educational revolutions with which I am acquainted. The change has been wrought by the efforts of a number of men who were sufficiently interested in science and sufficiently imbued with the spirit of the teacher to set to work and show that science could be made an invaluable mind-training study, and among these men I reckon Prof. Armstrong as a potent leader.

Prof. Armstrong renounces the claim, often imputed to him, of having discovered a new method of teaching. What he has done has been to formulate a scheme of teaching in accordance with principles which are almost as old as civilisation. The aim of this scheme has been to free science teaching from the dogmatic didactic methods by which it has been dominated, and to substitute a system which should yield the benefits of the experimental method. Two things, and two things only, I think, are essential to Prof. Armstrong's plan, first, that the pupils should perform experiments with their own hands, and second, that these experiments should not be the mere confirmation of something previously learned on authority, but the means of eliciting something previously unknown or of elucidating something previously uncertain. In this way only, it is maintained, can pupils gain the knowledge and use of scientific method. Incidentally, it is urged that the experimental studies should be made quantitative, and that a small number of problems should be studied thoroughly.

I cannot imagine that this view of the way in which science should be taught can be seriously disputed, and I think it is a pity that so many of Prof. Armstrong's

critics should have fastened on quite subsidiary matters and left his main contention unacknowledged.

I feel bound to admit that in some respects Prof. Armstrong has overstated his case. His advocacy has suggested that he desires the pupil to discover everything for himself and by himself, and so is incurred the criticism that it is ridiculous to expect a child to achieve in two or three years that which it has taken grown philosophers centuries of labour to achieve. A beginner cannot discover much for himself by himself, but a judicious teacher may lead him to discover much. I think that Prof. Armstrong has exaggerated the importance of quantitative work, great though that importance be. One has only to think of the achievements of Scheele in order to realise what a splendid thing qualitative work may be when faithfully performed. Again, the element of useful information must not be underestimated; we want to get the pupil along, and there is surely much that may be told, if it is properly presented and punctuated with experiments. In doing this there is no need to throw the pupil into a state of passive acceptance, still less of passive resistance; a good teacher knows how to avoid either.

Another point on which Prof. Armstrong's critics have fastened is his nomenclature. This is really a trifling matter, but such as it is I am on the side of the critics. "Chalk gas" seems unnecessary, even as a temporary name for carbon dioxide. Why not fixed air, which is both descriptive and historical? However, as I have said, such things are mere trifles.

In conclusion, I will express the opinion that it is not the matter of Prof. Armstrong's proposals that has created opposition, but the manner. There is probably no decent member of society more repugnant to the average Englishman than the aggressive educational reformer. If a man quietly records in books the outcome of his mature reflections and experience—well, you can avoid him by not reading his book, but if he appears at all your meetings with his new doctrines, if he invents new terms that dart promiscuously about the atmosphere of the educational world, and if eventually he gets known to the newspapers as a man likely to furnish occasion for the headline "animated debate," it is quite otherwise. If a man is a stylist like Matthew Arnold, deft with epigram, breathing a cultivated irony, he is forgiven everything for his literary excellence. But Prof. Armstrong has not chosen the persuasive method of Matthew Arnold. He is vigorous almost to violence, red-hot, scathing, scornful, uncompromising and incessant. He is no respecter of persons or institutions, however eminent, however ancient. He is absolutely impartial in his iconoclasm.

These peculiarities may have hindered the acceptance of improved methods. In any case, improvement could only have come in slowly, for it is laborious, and taxes the ingenuity as well as the diligence of the teacher. The eagerness of public administrators for speedy results, the false economy which gives the teacher no time to think, and the crowding of elementary classes, not only in the case of science, but all through the school course, are great obstacles to thoroughness. How idle it is to preach improved methods to an overworked teacher who has seventy, eighty or a hundred children to teach at once!

When all reasonable concessions have been made to his critics, it will, I believe, appear that Prof. Armstrong has rendered an inestimable service to the cause of true education.

ARTHUR SMITHELLS.

PRACTICAL ZOOLOGY.

First Report on Economic Zoology. By Fred. V. Theobald, M.A. Pp. xxxiv+192; 18 figures. (London: Printed by Order of the Trustees of the British Museum, 1903.) Price 6*s*.

THIS volume of reports on problems of economic zoology is very welcome. It represents a type of publication familiar in America, which has never been more than very rare in Britain; it is packed with valuable practical advice which must surely justify zoology in the eyes of any unconverted utilitarian; and it illustrates the nature and amount of scientific information on matters of economic importance which the staff of the zoological department of the British Museum "is almost daily called upon, and is prepared to furnish to the public service or to individuals." As is well known, this side of the Museum's work has been brought into particular prominence since Prof. Ray Lankester became director.

The contents are necessarily very heterogeneous, and afford a fine illustration of the multitudinous ways in which man's practical interests come into contact with animal life. We find discussions on cereal pests, root-crop pests, fruit pests, garden pests, forest pests, on poison for moles, on tapeworm in sheep, on the origin and varieties of domesticated geese, on dipterous larvæ in human excreta, on *Anobium tesselatum* in St. Albans Cathedral, on green matter in Lewes Public Baths, on the cigar beetle and the Teredo, on the tsetse fly and the Ceylon pearl fisheries, on the screw worm in St. Lucia, locusts in the Sudan, mosquitoes at Blackheath, and so on through a variety of subjects that is positively astounding. Mr. Theobald deserves warm congratulation on the impressiveness of his "First Report."

The variety of subjects which have had to be discussed in response to inquiries from the Board of Agriculture, the Foreign Office, the Colonial Office, and from private individuals makes the volume very multifarious, and gives a special appositeness to Prof. Ray Lankester's introductory scheme or outline of economic zoology. He gives a classified survey of the various subdivisions which it is found convenient to recognise in the treatment of this subject. This classification of animals in their economic relation to man, which recalls a little book by Dr. Edwin Lankester, proceeds from the simpler relations of primitive man and the animals around him to the more complex relations of civilised man with his endless arts and industries and circumscribed conditions. We give the classification in outline:—

Group A.—Animals *captured* or *slaughtered* by man for food, or for the use by him in other ways, of their skin, bone, fat, or other products. *Examples*:—

animals of the chase; food-fishes; whales; pearl-mussels.

Group B.—Animals *bred* or *cultivated* by man for food or for the use of their products in industry or for their services as living things. *Examples*:—flocks and herds; horses; dogs; poultry; gold-fish; bees; silkworms and leeches.

Group C.—Animals which directly promote man's operations as a civilised being without being killed, captured or trained by him. *Examples*:—scavengers such as vultures; carrion-feeding insects; earthworms and flower-fertilising insects.

Group D.—Animals which concern man as causing bodily injury, sometimes death, to him, and in other cases disease, often of a deadly character. *Examples*:—lions; wolves; snakes; stinging and parasitic insects; disease-germ carriers, as flies and mosquitoes; parasitic worms; parasitic Protozoa.

Group E.—Animals which concern man as causing bodily injury or disease (both possibly of a deadly character) to (*a*) his stock of domesticated animals; or (*b*) to his vegetable plantations; or (*c*) to wild animals in the preservation of which he is interested; or (*d*) to wild plants in the preservation of which he is interested. *Examples*:—Similar to those of Group D, but also insects and worms which destroy crops, fruit and forest trees, and pests such as frugivorous birds, rabbits and voles.

Group F.—Animals which concern man as being destructive to his worked up products of art and industry, such as (*a*) his various works, buildings, larger constructions and habitations; (*b*) furniture, books, drapery and clothing; (*c*) his food and his stores. *Examples*:—White ants; wood-eating larvæ; clothes' moths, weevils, acari and marine borers.

Group G.—Animals which are known as "beneficials" on account of their being destructive to or checking the increase of the injurious animals classed under Groups D, E, and F. *Examples*:—Certain carnivorous and insectivorous birds, reptiles and Amphibia; parasitic and predaceous insects, acari, myriapods, &c.

We have, then, in this "First Report on Economic Zoology" a large number of expert discussions of particular points—all of practical importance and some of theoretical interest as well; and we have also a luminous orientation of the whole subject. No one can help being impressed by the fact that zoology does not lose either in interest or in thoroughness as it becomes more social.

J. A. T.

IRRIGATION WORKS.

Irrigation Engineering. By Herbert M. Wilson, C.E. Fourth edition. Pp. xxiii+573. (New York: John Wiley and Sons; London: Chapman and Hall, Ltd., 1903.) Price 17*s*. net.

AN annual grant of about 500,000*l*. having been recently allotted by the Congress of the United States for the construction of irrigation works in arid regions, under the supervision of the director of the Geological Survey, various projects have been prepared with a view to their execution in the near future, which have already given employment to a number of engineers. This development has enhanced the importance of a sound knowledge of the principles of irrigation engineering, and has, accordingly, led the author to revise thoroughly and enlarge his book on the subject.

The area of land irrigated in the United States, reaching more than $7\frac{1}{2}$ million acres, is second only to India with 33 million acres, being larger than the irrigated area in Egypt of 6 million acres, in Italy of $4\frac{7}{10}$ million acres, and in Spain of $2\frac{1}{3}$ million acres. The States in which irrigation has been most resorted to are Colorado, California, Montana, Utah, and Idaho, with irrigated lands ranging from $1\frac{1}{3}$ million to half a million acres. After a very short introductory chapter on irrigation, the book is divided into three parts, dealing with hydrography, irrigation canals and canal works, and storage reservoirs respectively, in nineteen chapters altogether.

The subjects treated of in the first and third parts are, for the most part, similar to those contained in books on water-supply, the chief exceptions being chapter iv., on alkali, drainage, and sedimentation; chapter v., on the quantity of water required; and the end portion of the last chapter in part i., relating to sewage irrigation, which belongs strictly to sewage disposal. When the drainage of irrigated lands is not efficiently provided for, and an excess of water is carelessly distributed, any alkali in solution in the water accumulates by the evaporation which occurs as soon as the water rises to the surface, sodium carbonate being the most injurious to the soil; and the land also becomes water-logged and swampy, which, besides being bad for agriculture, is liable to occasion malarial fevers. Silt, which is brought down in large quantities in flood-time by many rivers, the waters of which are used for irrigation, is very valuable as a manure if it can be spread over the land, but it is very liable to deposit in the storage reservoirs and canals provided for irrigation, before the water reaches its destination; and the aim of the engineer is to convey the lighter and more fertile silt on to the land with the water, and to arrest the heavier silt before it reaches the reservoir, or to scour it out through sluices in the dam; and in the case of a diversion canal from a river, to arrange its entrance so as to keep out most of the heavier silt, and to make the remainder deposit in a part of the canal from whence it can be readily removed. The amount of water required to irrigate a given area depends upon the conditions of the locality and the crops raised, and forms the basis of all irrigation schemes.

The second part deals with works relating exclusively to irrigation in seven chapters, in which inundation and perennial canals, their alignment, slope, and cross section, headworks and diversion weirs, scouring sluices, regulators and escapes, falls and drainage works, distributaries and the application of water and pipe irrigation, are successively considered; and this constitutes the most important part of the book as regards irrigation. The book, however, as a whole, deals with the principles and practice of irrigation in a very complete manner, and is profusely illus-

trated by forty-one full-page views and plans, and one hundred and forty-two figures in the text; it is written in a simple style and printed in large type; and within a moderate compass the volume furnishes a large amount of information, combined with the results of experience, especially in the United States, which should prove of considerable value to engineers engaged in irrigating arid regions.

OUR BOOK SHELF.

Graphic Statics, with Applications to Trusses, Beams, and Arches. By Jerome Sondericker, B.S., C.E. Pp. viii+137. (New York: John Wiley and Sons; London: Chapman and Hall, Ltd., 1903.) Price 8s. 6d. net.

THIS is a very practical treatise on the determination of the forces in braced structures, beams, masonry arches, and abutments. It is based on a course of instruction given at the Massachusetts Institute of Technology. The author presupposes a knowledge of the strengths of materials, of the principles of statics, and of ordinary beam formula for stresses and deflections, and is thus able to present his methods in a very concise form without any lengthy preliminary explanation, and he pays special attention to the precautions which should be taken in drawing the diagrams in order to secure the best results.

The graphical processes are accompanied by analytical calculations, and the student is wisely encouraged to make himself familiar with both methods of computation, and not to follow either slavishly. Building construction is mainly drawn upon in providing examples, which include such cases as steel framed buildings under the action of gravitation loads and wind pressures. The author does not employ the strain energy method or its equivalent for structures with redundant elements, but proceeds by arbitrary assumption as to what seems probable in each particular case. This is often the only feasible plan, but too much reliance should not be placed on the results obtained. For instance, there is probably considerable error on p. 79 in the tacit assumption that the reactions in the trussed beam are the same as if the middle support did not yield. Considerable attention is given to frames where the members are subject to binding stresses as well as to direct stresses.

The three-hinged arch is dealt with, and some of the methods which have been proposed for determining the line of resistance in a masonry arch are briefly discussed; the author works out one example in full detail, showing how to find the linear arch which lies within a specified region (such as the middle third), and has the least horizontal thrust.

Memories of the Months. Third series. By Sir Herbert Maxwell, Bart. Pp. xi+290; illustrated. (London: Edward Arnold, 1903.) Price 7s. 6d.

THE author has no occasion to offer apologies for converting the "Memories" into a trilogy, and it is with sincere pleasure that we welcome this latest addition to a charming series, of which we hope we have not yet seen the end. Whether his subject be forestry, the habits and activity of squirrels, local place-names, salmon-disease, or "vole-plagues," Sir Herbert writes with a charm peculiarly his own, and, while imparting information, does so in a style which many of our best novelists might envy. Perhaps the highest praise we can bestow is to say that whenever one of the author's books comes into our hands for review, we invariably read it from beginning to end—and that with pleasure and satisfaction.

As Sir Herbert is not, we believe, a professed naturalist, a few slight errors, mainly due to lack of acquaintance with current zoological literature, could scarcely fail to occur in a work of this nature.

For instance, his arguments and conclusions drawn from the remarkable distribution of the fresh-water fishes of the genus Galaxias (p. 50) are rendered practically nugatory by the recent discovery of a marine representative of that group. Again, he does not appear to be aware that the Thessalian vole (p. 39) has been assigned to a new species by Captain Barrett-Hamilton, under the name of *Microtus hartingi*. We may also direct attention to the practical repetition, on pp. 46 and 47, of the account of the damage inflicted on Scottish pine forests by crossbills given on pp. 1 and 2, the repetition extending even to the fading of the crimson of the head and neck of the bird to dull greenish-olive after death. Another repetition will be found by comparing pp. 73 and 115, in connection with the origin of the name Winchester; with the discrepancy that "Gwent" is stated to mean "white" in the latter, and "downs" in the former passage. Finally, the misprint *Odicnemus* on p. 102 is scarcely consonant with the author's predilection for etymology.

Where all is interesting, it is difficult to select passages for special notice. Attention may, however, be directed to the calculation of the muscular activity of the goldcrest as contrasted with that of man (p. 40). It may also be noted that the author defends his contention as to the limited height to which holly is prickly by the remark that when this has been called in question it is owing to artificial strains, and not the natural wild stock, having been the subject of observations.

With this we must take leave of a volume as charming and full of interest as its predecessors. R. L.

Educational Woodwork. By A. C. Horth. Pp. 159. (London: Percival Marshall and Co., n.d.) Price 3s. 6d. net.

THE author has attempted to provide, within the restricted limits of a hundred and sixty pages, a three years' course of woodwork, drawing, and object lessons; chapters on discipline, organisation and method; particulars as to the fittings and furniture required for the exercises, as well as hints on the instruction of deaf, blind, and special children. At the same time he has found space for nearly two hundred illustrations. The consequence is that the instructions are meagre, and in many cases quite inadequate. The illustrations in the earlier pages are good, but some of the drawings intended to help the object lessons outlined in chapter viii. will fail to convey much meaning to pupils. The courses of woodwork are also published separately in pamphlet form at fourpence net for each year.

Die Proportion des goldnen Schnitts. By J. Kübler. Pp. 36. (Leipzig: B. G. Teubner, 1903.)

THIS is an attempt to discuss the properties of quantities in continued proportion, and in particular the series of proportionals derived from the problem of medial section, in connection with a large number of mathematical, physical, and even physiological problems.

If books of this kind are written and read as a recreation by people who enjoy thinking about semi-mathematical and semi-philosophical considerations, and who merely take the conclusions arrived at for what they are worth, without attaching special scientific value to them, then the present volume completely fulfils its object.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

The Royal Society.

AT the special meeting of the Royal Society held on January 21, when the constitution and functions of the sectional committees were under consideration, the opinion was expressed by more than one speaker that the usefulness of the society in encouraging and advancing scientific work is not what it might be; but no very definite suggestions were made with a view to its improvement.

It seemed to me that the functions of these sectional committees had a good deal to do with the lack of scientific enterprise which we observe in the Royal Society, and that they might with advantage be done away with.

As many of the fellows had left the meeting before I spoke, and as everything that affects the efficiency of the Royal Society concerns the public, I crave the hospitality of the columns of NATURE to develop as shortly as possible my views on this matter.

The main function of the sectional committees is to *refer* papers received by the society from fellows, to some other fellow or fellows of the society to be certified that they are or are not fit to be accepted and published by the society.

It is well known that the fellows of the society are *de facto* chosen by the council after rigid scrutiny and the most careful inquiry, and the only object of this scrutiny and inquiry is to satisfy the council that the candidate whom it recommends is a man of eminence in his own science, and that the work which he is likely to do will be a credit to the society. So convinced is the society of the thoroughness and impartiality with which the council discharges this duty that the confirmation of its selection by election has come to be a pure formality. This being so, it cannot fail to surprise the newly elected fellow, when he proceeds to justify his election by doing work and communicating the results of it to the society, to find that he is now in no better position than he was before he was elected. His work is *referred* in the same way as that of any outsider. His recent selection by the council is ignored by that body or is regarded as having no weight, and it treats him, scientifically, as a perfect stranger.

Furthermore, this *reference*, which amounts to neither more nor less than a secret revision of the title of the fellow to the privileges of the society, is repeated on every occasion when he comes under the notice of the society by offering it work. So long as he is content to be a passive fellow, or at least an inactive one, he is spared this injustice and indignity. It is no wonder then that the fellowship of the Royal Society has come to be looked on as an invitation to repose rather than as an incentive to work.

How different is the state of things which we observe in the parallel society in France, the Academy of Sciences. Its constitution is thoroughly democratic, and all its proceedings are inspired by enlightened self-respect. But we need only contemplate the work which it puts through in the year and compare it with what is turned out by the Royal Society to see that there is something for us to learn by its study.

First and foremost the academy meets fifty-two times in the year, namely, on every Monday, with the exception of Easter Monday and Whit Monday, and then it meets on the following Tuesdays. By the time-table of the current year the Royal Society is to meet twenty times.

Papers by members, or communicated by members of the academy, are not obliged to be sent in before the meeting. The *agenda* of the meeting is compiled at the meeting, each member who has a paper to communicate giving notice of it to the secretary on his arrival in the room, and the papers are taken strictly in the order of their intimation. If the paper communicated by the member is to be published in the *Comptes rendus* of the sitting, it has to be handed in to the secretary at the sitting; the corrected proof has to be returned to the printer on the Wednesday evening, and it is then published without fail on the Sunday. The communication, reading, and publication of a paper presented to the academy is therefore an affair of the inside of a week, and it is a certainty. This promptitude in the putting through of work is due to the fundamental fact that when a man is elected a member of the academy he enters at once into the full enjoyment of all its privileges, and one of the chief of these is the complete confidence of all his fellow-members. When he communicates a paper, whether it be by himself or by someone not a member of the academy, it is accepted without question. The only limitation in the privileges of members is with regard to the space that they are entitled to claim in the *Comptes rendus*. A paper by a member or foreign associate of the academy may fill six pages per number, and his communications in the year may fill fifty pages in all, and this as a matter of right.

It is unnecessary to occupy more space in order to show what a powerful engine the Academy of Sciences is in the production and encouragement of work, or to indicate how easily the Royal Society may successfully rival it. Let every fellow of the society, whether he be on the council or not, have complete confidence in his fellow-fellows and give practical effect to it, and the thing is done. The rest will follow of itself.

J. Y. BUCHANAN.

January 23.

The Radiation from an Electron describing a Circular Orbit.

THE complete formula for the radiation may be useful to some of those who are now indulging in atomic speculations. It is derived from the general formula I gave a year ago in NATURE (October 30, 1902), expressing the electromagnetic field everywhere due to an electron moving anyhow. Put in the special value of R required, which is a matter of elementary geometry, and the result is the complete finite formula. But only the part depending on R^{-1} is required for the radiation; and, in fact, we only want the r^{-1} term (if r=distance from the centre of the orbit), if the ratio of the radius of the orbit to the distance is insensible, and that, of course, is quite easy, on account of the extreme smallness of electronic orbits. The magnetic force is given by

$$H_\phi = \frac{Qun}{4\pi rv} \alpha^3 \cos\theta \cos\phi_1, \tag{1}$$

$$H_\theta = \frac{Qun}{4\pi rv} \alpha^3 (\sin\phi_1 - \beta), \tag{2}$$

subject to

$$\alpha = \frac{1}{1 - \beta \sin\phi_1}, \quad \beta = \frac{u}{v} \sin\theta, \tag{3}$$

$$\phi_0 = \phi_1 + \beta \cos\phi_1 = \phi - nt + nr/v. \tag{4}$$

There is no limitation upon the size of u/v, save that it must be less than 1. But there is a limitation regarding the acceleration. If the change in the acceleration is sensible in the time taken by light to traverse the diameter of the electron, it will sensibly alter the results. The size of the electron itself will then have to be considered. But this is very extreme. To explain the symbols: the (surface) charge is Q moving at speed u and angular speed n in a circle in the plane perpendicular to the axis from which θ is measured. It revolves positively round this axis, and its position when $t=0$ is $\phi=0$. Also, r, θ, ϕ are the usual spherical coordinates of the point of observation, and H_ϕ, H_θ are the ϕ and θ components of the magnetic force at that point at the moment t. The coefficient α^3 shows the Doppler effect on **H**. The difference between ϕ_0 and ϕ_1 must be noted.

It will be readily seen what an important part the Doppler effect plays if, as has been sometimes assumed, subatomic motions of electrons involve values of u which are not insensible fractions of v. For instance, in the plane of the orbit, $H\phi=0$, and

$$H_\theta = \frac{Qun}{4\pi rv} \frac{\sin\phi_1 - u/v}{[1 - (u/v)\sin\phi_1]^3} \tag{5}$$

The effect is to compress H in one half and expand it in the other half of a period, with corresponding strengthening and weakening of intensity, and also with a shifting of the nodes towards the compressed part. When u/v is made large, there is a great concentration at $\phi_1=\phi_0=\frac{1}{2}\pi$, $2\frac{1}{2}\pi$, $4\frac{1}{2}\pi$, &c., with only a weak disturbance of opposite sign between them. That is, there is a tendency to turn the original simply periodic vibration into periodic pulses, which become very marked as u increases towards v. The radiation of energy is very rapid. It involves (*l.c.*) the factor $(1-u^2/v^2)^{-2}$. This becomes so great as seemingly to shut out the possibility of anything more than momentary persistence of revolution. But there might be a solitary partial revolution, or nearly complete, in cometary fashion, which would generate a single pulse, if there cannot be a sequence of several at speeds nearly equal to that of light.

Three suggestions have been made about the X-rays. Röntgen suggested a longitudinal ether disturbance. This has not found favour, because it requires a new theory of electricity. Schuster suggested very rapid vibrations. This is tenable, because in the inside of an atom rudimentary calculations show that vibrations much more frequent than light are easily possible with revolving electrons. Stokes suggested collisional pulses. This is tenable too, for the collisions must produce electromagnetic pulses. I think X-rays are mixed Stokes pulses and Schuster vibrations, the latter arising from the atoms of the body struck. Now a pulse is not the same as a continued vibration, though it may be analysed into the sum of various sorts of continued vibrations, just as the distorted simply periodic vibration in (5) above may be. There ought, then, to be a physical difference between the effects of collisional pulses and continued very rapid vibrations. Apart from the emission of electrons and matter, there might be six sorts of radiation at least, say, light vibrations, below light, above light, collisional pulses, cometary pulses, and possibly periodic pulses. The last may have to be excluded for the reason mentioned. The cometary pulses would resemble the collisional pulses, though less dense. The above light vibrations need not require u/v to be more than a small fraction, though even then their maintenance is a difficulty. They require renewal again and again, perhaps in a collisional manner. There is a good deal to be found out yet in the relations of electricity to matter. There is also sometimes a good deal of misconception as to the relations of theory to fact. A purely dynamical theory of electricity, like Maxwell's, can give no information about the connection between electricity and matter. For example, Zeeman's experiment, as interpreted by Lorentz, brought out the striking fact that it was the negative electricity that revolved, not seemingly the positive, and the fact harmonises with J. J. Thomson's negative corpuscles. Theory could never predict such a fact, because it is not in the theory. It could not be there, because it has no dependence upon the dynamics of electricity in the theory. The same may be said of various other new facts much discussed of late. Now, though the theory cannot predict such facts, it is useful, of course, as a guide in framing hypotheses to account for the new facts, for it is no use flying in the face of solid theory. Whether the solid theory itself (not meaning that the ether is solid) will need to be altered remains to be seen. There is no sign of it yet, though I cannot believe the ethereal theory is complete.

To analyse the dopplerised vibrations expressed by (1), (2) into simply periodic vibrations seemed to involve very complicated work at first, save just for two or three terms. But there is a trick in it, which, when found, allows the complete expansions to be developed in a few lines. First show that (this is the trick)

$$\alpha^3 \cos\phi_1 = -\frac{d^2}{d\phi_0^{\,2}}\cos\phi_1, \quad \alpha^3(\sin\phi_1-\beta) = -\frac{d^2}{d\phi_0^{\,2}}\sin\phi_1. \quad (6)$$

Next, by the theorem known as Lagrange's, $\sin\phi_1$ can be at once put in the form of a series involving the derivatives of various powers of $\cos\phi_0$. Do not find the derivatives from them, but put $\cos^n\phi_0$ in terms of the sum of first powers of cosines by the well known circular formula. The full differentiations, not forgetting those in (6), may then be done at sight in one operation. The result is

$$\alpha^3(\sin\phi_1-\beta) = \sin\phi_0 - \beta \cdot 2\cos 2\phi_0 - \frac{3}{8}\beta^2(9\sin 3\phi_0+\sin\phi_0)$$
$$+\frac{4}{3}\beta^3(4\cos 4\phi_0+\cos 2\phi_0) + \frac{\beta^4}{\underline{|4}}\,\frac{1}{2^4}\Big(5^5\sin 5\phi_0 + 5\cdot 3^4\sin 3\phi_0$$
$$+10\sin\phi_0\Big) - \frac{\beta^5}{\underline{|5}}\,\frac{1}{2^5}\Big(6^6\cos 6\phi_0 + 6.4^4\cos 4\phi_0 + 15.2^4\cos 2\phi_0\Big)$$
$$-\ldots \quad (7)$$

and so on to any extent. Then, to find the other one, differentiate the series in (7) with respect to ϕ_0 and divide the nth term by n. Thus

$$\alpha^3\cos\phi_1 = \cos\phi_0 + 2\beta\sin 2\phi_0 - \frac{\beta^2}{8}\Big(27\cos 3\phi_0 + \cos\phi_0\Big) - \ldots \quad (8)$$

and so on. This analysis of the vibrations is useful in some special developments, but of course the original distorted simple vibration is the most significant. In fact, the result of the analysis exhibits the common failing of most series developments that the resultant meaning is not evident.

Another way. Use Bessel's series for the sine and cosine of ϕ_1, and then carry out (6). It is remarkable that the relation between the eccentric and mean anomaly in a planetary orbit should be imitated, for the dynamics is quite different.

When I was a young child I conceived the idea of an infinite series of universes, the solar system being an atom in a larger universe on the one hand, and the mundane atom a universe to a smaller atom, and so on. I do not go so far as that now, but only observe that there is a tendency to make the electrons indivisible, and all exactly alike. But they must have size and shape, and be therefore divisible. Unless, indeed, they are infinitely rigid. Or they may vary in shape without dividing. There are infinite possibilities in the unknown. Kaufmann's measurements go to show that the mass of an electron, if there is any, is only a small fraction of its effective electromagnetic mass, although that is not a definite quantity subject to the Newtonian second law. But it is too soon to say that the electron has no mass at all, that is, to be quite sure that negative electricity is absolutely separable from matter, though it seems likely. It would be well to have, if possible, similar measurements made on positive electricity. If permanently attached to matter, it should not exhibit the increased inertia with increased speed in a sensible manner.

January 11. OLIVER HEAVISIDE.

Atmospheric Electricity.

YOUR correspondent Mr. George Simpson truly points out that the sun's α rays would be stopped by the upper atmosphere, whereas his β rays would penetrate much further; and perhaps he may have also noticed that an energetic separation of these oppositely charged rays would be effected by the earth's magnetic field, the negative being conveyed toward the poles, and the positive remaining near the tropics along with the maximum sunshine.

Consequently quadrantal earth-currents would be generated, and likewise a Leyden jar action would be set up in the tropical region of the lower atmosphere, sufficient to account for prevalent tropical thunderstorms. Some magnetic perturbations could also be accounted for.

OLIVER LODGE.

Nomenclature and Tables of Kinship.

A CIRCULAR letter, arranged like the following, is about to be issued for carrying out certain inquiries into heredity, and I am anxious, before taking a more definite step, to have it criticised and to receive suggestions. I send it to NATURE not only for my own advantage, but because I think it will interest those readers who occupy themselves in analysing experiences in breeding animals of any kind, although this table has been specially designed to receive hereditary facts concerning man.

The processes that it is desired to facilitate are, in out-

line, as follows:—Some marked peculiarity is determined on to be made the subject of study. It may be an excess or deficiency of some normal character, or it may be a trait, a feature, a disease, or a monstrosity, the process being the same in all these cases. The inquirer then endeavours to trace its hereditary distribution. He fixes upon some individual who possesses the peculiarity in a highly marked degree, and traces the frequency and intensity with which it occurs among his kinsmen. He tries to do so exhaustively by compiling the facts relative to those kinsmen in each and every degree to as great a distance of kinship as he is able, or cares, to go. He follows a similar course in respect to many other individuals belonging to as many different families, and finally he obtains average results by well-known methods. I am speaking solely of inquiries

Distribution of the Peculiarity X *in the Family of* A. B.

fa=Father or father's, according to its place; similarly, *me*=Mother; *bro*=Brother; *si*=Sister; *so* (or *son* where more euphonious)=Son. The links in the chain of kinship are to be read as leading outwards from A.B. Thus, *me da* signifies "A.B.'s mother's daughter is." *fa bro son* means "A.B.'s father's brother's son is."

Ordinary names for generalised kinships	Titles showing the precise chain of kinships	Adults alone: Total No. of sons and daus	Adults alone: Initials of those whose X deserves record	Titles showing the precise chain of kinships	Adults alone: Total No. of sons and daus	Adults alone: Initials of those whose X deserves record	Names in full of those whose initials appear in the preceding column
Grandfather	*fa fa*	1		*me fa*	1		
Grandmother	*fa me*	1		*me me*	1		
Uncles ...	... *fa bro*			*me bro*			
Aunts ...	... *fa si*			*me si*			
Father ...	... *father*	1		—	—	—	
Mother...	... *mother*	1		—	—		
Brothers	.. *brother*			—	—		
Sisters ...	... *sister*			—	—	—	
Half-brothers	*fa son*			*me son*			
Half-sisters	*fa da*			*me da*			
Nephews ..	*bro son*			*si son*			
Nieces ..	... *bro da*			*si da*			
First cousins Male ...	*fa bro son* / *fa si son*			*me bro son* / *me si son*			
First cousins Female...	*fa bro da* / *fa si da*			*me bro da* / *me si da*			

Maiden name of the wife	Year of marriage	Number who survived infancy: sons	Number who survived infancy: daus	Initials of those whose X deserves record

directed to what I would call the *actuarial* side of heredity, because they are analogous to those made by actuaries with medical experiences to determine the just rates of insurance in respect to expectation of life and other vital phenomena.

The ambiguity and cumbrousness of the ordinary terms of kinship are serious obstacles in carrying out these researches; it is also very difficult to present the results in a compact form by any established method. I have endeavoured to overcome both difficulties, the latter by the arrangement of the present table, and the former by the use of syllables, which give a perfectly distinctive description, and which, in addition to the advantage of brevity, have those of being easily intelligible, euphonious, even though they may be a trifle absurd, and capable of the most extended application. The details of the peculiarity X, as they appear in the several persons named in the last column of the table, are supposed to be entered in a corresponding number of paragraphs on a separate sheet. After more trials and failures than would be easily credited, I think I have at last succeeded fairly well. Still, as I began by saying, I should be very grateful for useful suggestions. The table admits of indefinite extension, with no alteration of method. It will, of course, be understood that each successive step in the line of descent introduces a new element that may seriously affect the previous influences. Much might be added, but I think that with the aid of a little reflection the arrangement of the table will explain and justify itself.

FRANCIS GALTON.

The Source of the Energy of Radium Compounds.

IF I understand Prof. Rutherford's communication aright (NATURE, January 7, p. 222), he concludes from the constancy of radio-active results with a solid radium salt and the same diluted that the energy of radium compounds cannot be derived from external sources. The matter is of such wide scientific interest that I ask your permission to present concisely the contra argument.

(1) When a coloured solid is dissolved the amount of absorption of light effected by the solid is equal to the amount of light absorbed by its solution. Thus I have shown that a plate of solid bichromate of potash 0·71 millimetre in thickness effects the same absorption of light as 6 centimetres of solution containing 0·0309 gram of the salt per cubic centimetre, as in each case the same number of bichromate molecules or molecular aggregates is acting on the light. To be perfectly clear, taking the specific gravity of bichromate of potash as 2·617, we have in the former case a rectangular bundle of rays 1 square centimetre in section passing through $0·71 \times 0·2617 = 0·1858$ gram of solid, while the bundle of rays in the latter case passes through $6 \times 0·0309 = 0·1854$ gram of dissolved bichromate (see *Chem. News*, October 5, 1877).

(2) It has been amply demonstrated that the absorption of X-rays follows the same general laws as the absorption of light; thus the amount of both kinds of radiation absorbed increases (1) with the thickness of the body passed through, and (2) with the molecular weight in a comparable series of bodies ("The Old Light and the New," 1896, pp. 73–80).

Therefore if it be postulated that the energy of radium is due to the absorption of "an unknown external radiation" "similar in character to the radiations which are emitted," viz. the γ rays, then the mere act of dilution of a milligram of radium bromide will not affect its constancy of absorption, and therefore also will not materially influence its radio-activity.

WILLIAM ACKROYD.

Borough Laboratory, Halifax, Yorks.

γ-Rays from Radium.

FROM the letter of Prof. Rutherford in NATURE of January 7 it is improbable that γ rays from radium are Röntgen rays generated by self-bombardment. The γ rays must therefore arise from radium directly, and not as a secondary effect of bombardment.

It may be useful here to recall a remark made by Sir George Stokes at a meeting of the physical colloquium of the Owens College, Manchester, shortly before his death. Commenting on Becquerel rays, he likened the discharge of kathode rays to the discharge of a gun, the impact of kathode projectiles on a target creating an ethereal disturbance recognised as Röntgen rays. But, he said, in the same way as there is an explosive disturbance in the gun where the bullets issue, so there must also be a violent ethereal disturbance, not only where kathode rays strike, but also where they issue.

Is it not just this disturbance where β rays issue which is now being detected in γ rays, and is it not quite consistent with this view that the explosive disturbance of the atom which produces α and β rays should at the same time generate something akin to Röntgen rays?

J. R. ASHWORTH.

105 Freehold Street, Rochdale, January 16.

Phosphorescence of Photographic Plates.

I HAVE frequently observed the phenomenon described in your correspondent's letter published in NATURE of January 14 on treating plates which had been exposed to the action of Röntgen rays, with a solution of alum.

I first noticed it in June, 1898, and the temperature of the dark room was 23°. The film being "hardened" was that on an "Ilford Special Rapid Plate," which had been subjected to a somewhat protracted development with pyrogallol; on pouring a $7\frac{1}{2}$ per cent. solution of common alum over the plate, the liquid lit up with a pale phosphorescence, not unlike that seen on stick phosphorus on a warm night, which continued for about ten seconds and then faded away.

Plates developed with ferrous oxalate also glow occasionally under similar conditions, and phosphorescence seems to take place only when the film has not been exposed to ordinary light, and when the surrounding air is exceptionally warm. JAMES F. RONCA.

Clapham, S.W., January 23.

WITH reference to the letter from Mr. T. A. Vaughton in your issue of January 14 regarding the phosphorescence of silver bromide, it is worth noticing that this is not a function of the silver haloid salt.

Whilst working here for Dr. W. J. Russell, F.R.S., I chanced to empty some spent pyro developer and a dilute solution of alum into the sink of the dark room at the same time, when the whole liquid at once glowed with a brilliant phosphorescence.

This takes place whenever a dilute aqueous solution containing pyro, a soluble sulphite, and an excess of alkali is made acid. It occurs even when the amount of pyro is very small, but it is essential that the solution be alkaline. If the pyro be mixed with sodium sulphite alone, although the latter be in sufficient quantity to ensure faint alkalinity, the solution remains colourless and does not phosphoresce; an oxidation of the pyro seems to be necessary.

Either a dilute solution of a mineral acid, of an organic acid, or of an acid salt can be used to acidify the pyro.

This phenomenon is not a new one, but so far as I am aware has never been studied. O. F. BLOCH.

The Davy Faraday Research Laboratory,
Albemarle Street, W., January 20.

M. Blondlot's *n*-Ray Experiments.

ABOUT three months ago I independently discovered that a feebly luminous phosphorescent zinc sulphide screen when brought near the body increased in brightness.

I mentioned this fact to Mr. H. A. Taylor, remarking that I believed it to be the effect of an undiscovered ray given off by the flesh; he suggested, however, that heat was the cause of the phenomenon.

Further trials showed this to be the case; by laying the back of the screen against a fluted jar filled with warm water the zinc sulphide would brighten up along the edges of the fluting and clearly indicate the pattern; on removing the screen the light would fade, showing the pattern now as dark lines against a lighter background.

With care screens of sulphide of zinc or of calcium may be made highly sensitive to warmth, and by this means it might be possible to photograph many dark bodies simply by means of the heat rays given off, provided a suitable lens was employed. S. G. BROWN.

4 Great Winchester Street, London, E.C., January 23.

Curious Shadow Effect.

I SHOULD feel obliged, if not troubling you, if you could tell me where I could obtain information with regard to the following:—

During the Christmas holiday my brother and I were in North Wales, and happened to be on the ridge that lies north of Llyn Llydaw; the sun was about 1h. from time of setting, and was low enough to clear the lower edge of the thin clouds which came from a northerly direction. The hollow (Cwm Glas) to the north of the ridge was, every now and then, filled up with thin mist on which our shadows were projected; surrounding the shadow was a faint oval-shaped rainbow, which, as the sunlight strengthened, became brighter, and a second bow outside the one nearest to the figures appeared, though very faintly. Although my companion was within a few feet of me, we each saw our *own* shadows only. We also saw, when the mist was

further from us, a shadow of the ridge itself with our two figures on it, in this case the figures appearing much smaller than in the other effect, and without any bow.

These phenomena are, I believe, not rare on this ridge, certain conditions, such as a bright low-down sun behind one, and a fairly opaque mist in front, being, of course, necessary.

The point on which I desire information is why the bows

should be of this oval form, and why they should appear at all?

The *shadow* of one's figure I can more readily understand.

The little pencil sketch enclosed may perhaps explain my description. H. M. WARNER.

44 Highbury Park, N., January 14.

Destructive Action of Rain upon Animal Life.

THE protracted and heavy rains during periods of the past year must have imposed a severe strain upon the smaller and more fragile forms of animals, such as, for instance, plant lice, mites, many of the smaller species of insects, spiders, &c. Even if adults are able to withstand the destructive effects of torrents of rain, it is difficult to understand how very immature examples, or individuals that have recently undergone ecdysis, can survive. During prolonged and heavy rain over a mixed tract of country the available shelter is relatively very small. Practically the whole surface soil becomes sodden, and, in the open at any rate, almost the whole vegetation is drenched. In some plants, as is well known, the flowers and certain areas of the leaves and other parts afford shelter, but even taking this into account, it would seem that the injury must be very great. In the county of Sussex during ordinary June

or July weather the number of small creatures harbouring in such a position as, say, a patch of rank herbage near water is truly astonishing. During the last ten years I have often visited such positions in heavy rain, and I am convinced that great mortality is caused, but I have not been able to satisfy myself whether this is due to drowning, burial in the soil, the impact of falling drops, or to some other cause or combination of causes.

Over an area not subject to violent meteorological fluctuations, the fauna will assume a condition of equilibrium. Any sudden and wide departure from the mean conditions for the particular season of the year will have an immediate and profound effect. I venture to write, therefore, in the hope that someone will pay special attention to the effects of such periods of abnormal rainfall as we have had during the last few months. The subject does not appear to have received the attention it merits, and the inquiry might profitably be extended so as to cover other meteorological effects.
W. RUSKIN BUTTERFIELD.

4 Stanhope Place, St. Leonards-on-Sea, January 17.

Subjective Images.

THE letter on the above subject (p. 271) reminds me of one that I sent to NATURE in 1871 (vol. iv. p. 122) describing a phenomenon complementary to that observed by Mgr. Molloy. I was induced to write it in consequence of a communication by Mr. T. Ward (NATURE, vol. iv. p. 68), who observed that the white chalk lines on a blackboard appeared to be blue when the sun was shining on his eyes; I noticed that the printing in a book looked bright red when I was walking on a chalk road, the book being shaded by an umbrella.

There appears to be a connection between the three phenomena, but I will not venture to suggest an explanation; possibly the persistence of colours may be different in different eyes.
HERBERT MCLEOD.

January 23.

IN response to Dr. Molloy's appeal, I may mention that a correspondent of *Work* having asked the reason for the colours in Benham's artificial spectrum top, I made, in the number for April 6, 1895, a suggestion which is practically the same as his explanation. This was that the optic nerves which according to the Young-Helmholtz theory produce the sensation of violet, are the most easily excited of the three sets, and that those producing the sensation of green, having the greatest inertia, are least easily excited and retain the impression for a longer time than the other two. In the number of the same journal for January 11, 1896, other phenomena were cited which might be explained by the same hypothesis.
ALEX. THURBURN.

Keith.

IT seems probable that the effect mentioned by Dr. Gerald Molloy in your issue of January 21 is the same effect—produced in a different way—as that I spoke of in my letter published in NATURE of January 14.

In the instance he mentions we have black letters on a white marble slab, viewed by eyes in a partially dazzled state from the effect of strong sunlight. In the case to which I directed attention, these conditions are almost reproduced, viz. the blackened silver bromide on a white porcelain dish under a dazzling red light. Before the developing solution is added, the bromide under the red light appears as a grey powder in a white dish, but on adding the developing solution it is blackened, and when the liquid is poured off the change from black to bright green may be conveniently observed. The angle at which the dish is viewed seems not to be without influence on the brightness of the colour. Under the best conditions the bromide has the appearance of masses of uncut emeralds.
T. A. VAUGHTON.

Ley Hill House, Sutton Coldfield, January 23.

Abysmal Deposits.

I BELIEVE there is some difficulty in accounting for the difference in the distribution of living Foraminifera at the surface of the sea and of deposits of their skeletons at the bottom. As is well known, the abysmal deposits contain no Foraminifera, while the much vaster pelagic deposits consist chiefly of them. The difference in depth has suggested that in the case of the pelagic deposits the free carbonic acid in the water has not had time to dissolve the sinking skeleton, while it has had time before a skeleton can reach the greater depths occupied by the abysmal deposits. But surely if this were the whole truth some effect would have been produced by the time the skeleton had sunk 2000 or 2500 fathoms or even less, so that it ought to be impossible to find, as we do, perfect skeletons in the globigerina ooze.

I wish to suggest a theory which is new, so far as I know, viz. that solution does occur, but does not begin until the organic matter protecting the carbonate of lime has all putrefied away. Hence the solution may be begun and ended in the excess of depth which the abysmal parts of the ocean-bed have over the pelagic parts.
H. ROBSON.

29 Hurlbutt Street, Newington Butts, S.E.

Spelling Reform.

IN your review of Dr. Joseph Bowden's "Elements of the Theory of Integers," there is included a severe condemnation of the very moderate instalment of spelling reform which the author appears to have introduced into his work. A discussion on the general question of spelling reform would, of course, not be suitable to your pages, and I therefore confine myself to making a respectful remonstrance against your reviewer's sweeping condemnation of what I conjecture to be an attempt to remedy a few of the glaring inconsistencies and anomalies of the current English spelling. Other languages have, from time to time, reformed their spelling so as to bring it more into harmony with the pronunciation, and this has been the case in our own time with German. It can scarcely be doubted that, sooner or later, the same will be the case with English. In that event the spellings you quote will certainly be adopted, with the exception of "*fixd*," which will, of course, be spelt *fixt*.
T. B. S.

Edinburgh, January 15.

MAY I point out that Dr. Bowden's book purports to deal with the "Elements of the Theory of Integers," and not with questions of spelling reform? Neither on the title-page nor in the preface does the author make any claim to address his work to those members of the community who prefer to have their thoughts expressed in a written language differing from that of their fellow beings. Failing any such indication, it must be assumed that the work is intended to be read and criticised by English speaking and English writing readers of the present day, to whom the author's spelling of the words in question must appear to be grossly incorrect. I quite agree with T. B. S. that "a discussion of the general question of spelling reform," as exemplified by the modern German equivalent of *red*, would "not be suitable to your pages."
THE REVIEWER.

RESEARCHES RELATING TO RADIUM.

THE year just passed has witnessed a widespread interest among all classes of people in Mme. Curie's discovery of radium, and attention has been generally directed to the nature of the new property of matter which it exhibits to such a surprising degree. The far-reaching consequences of M. Becquerel's discovery of radio-activity for the element uranium on our ideas with regard to the relations between energy and matter, although they have been long recognised by those immediately connected with the development of the subject, are now universally admitted. The million-fold more powerful radium appeals to the practical as well as to the academic imagination, and the problems raised by the new property have been brought into universal prominence. Owing to the excellent work of Giesel in improving the methods of extracting the new element from its

ores, and to the enterprise of the Chinin-Fabrik, of Brunswick, many during the past year have had the opportunity of satisfying themselves by experiment that the marvellous properties attributed to radium have not been exaggerated.

Considering the short time that has elapsed since the discovery, and the difficulty experienced in the past in obtaining the element, our knowledge of its properties at the present time is surprisingly complete. Attention will here be mainly directed to outstanding features which need further inquiry. In the first place, in spite of the many years of painstaking labour devoted to the determination by Mme. Curie, doubt still lingers as to the atomic weight of the new element. The case is a remarkable one, and has never arisen before in the determination of an atomic weight. On the one hand we have Mme. Curie's experimental value 225, and on the other an indirect value, 257·8, arrived at by Runge and Precht from spectroscopic data. Each of these determinations rests upon evidence which cannot be lightly set aside, and the discrepancy still remains to be explained. We have the authority of M. Demarçay for the purity of the preparations employed by Mme. Curie, for the former states that the spectroscopic trace of barium present could have had no effect on the atomic weight determination.

In ordinary circumstances the value 225 would probably be accepted as trustworthy to a unit in either direction. Runge and Precht's result, on the other hand, cannot be ascribed to chance relationships between the lines in the spectrum, possessing no real physical significance. For they succeeded in sorting the lines into related series, the lines in each series being resolved in the same way in a magnetic field. The series for radium are strictly analogous to those previously recognised in the spectra of the other alkaline-earth elements, and the connection between the atomic weight of the element and the distance apart of the lines in the series, which is the same for the different series of the same elements, holds very exactly for the cases of magnesium, calcium, barium and strontium. For radium, however, the number 257·8 is indicated. The evidence drawn from the chemical nature of radium and from the character of its spectrum agrees, however, in making the new element a member of the alkaline-earth family, and the experimental number is the only one which admits of this classification in the periodic table. The higher value, if it allows of the element being placed in the group of divalent metals at all, would make radium analogous to mercury and cadmium, so that it seems as if the experimental number should be accepted and the spectroscopic value regarded as abnormal for some unknown reason. The question is of considerable importance, and it is to be hoped that new experimental determinations will soon be available.

An explanation of the property of radio-activity was put forward by Prof. Rutherford and the writer about a year and a half ago as a result of the discovery of thorium X and of the behaviour which the thorium from which it is separated exhibits. This has since been developed and extended to afford a working hypothesis applicable to every detail of the phenomenon. The radio-elements are regarded as slowly disintegrating, a definite proportion of the total changing in the case of each element in the unit of time, the change being marked by the expulsion of rays. On account of the fact that the disintegration proceeds *per saltum* through several stages, and once started proceeds from stage to stage comparatively rapidly, the infinitesimal amounts of the transition-forms of matter can be detected and studied on account of the rays they emit in passage to the next succeeding stage. On this view thorium X, the uranium X of Crookes, the emanations of radium and thorium, and the active matter resulting from the further change of the latter, which gives rise to the phenomenon of "induced" or "excited" activity, are all transition-forms in the *per saltum* disintegration of the parent elements into more stable systems. The emanations are perhaps the most remarkable of these forms, as they are gaseous, and in consequence have been the most narrowly studied since the original discovery of the thorium emanation by Rutherford in 1899. The energy given out is, on this view, derived from the store of internal energy of the changing atom, and is, for any given mass of matter changing, enormous compared with that involved in any previously known change. It is in consequence of this fact that the excessively minute changes which produce radio-activity can be detected and investigated.

With regard to the nature of the radiations, the advances made by Rutherford in our knowledge of the nature of the α rays are among the most important. The β rays are known from the work of J. J. Thomson and Becquerel to consist of high velocity kathode rays, or negatively charged particles of mass about one-thousandth of the hydrogen atom projected with a velocity approaching that of light. The γ rays are in all probability X rays of high penetrating power which accompany the production of the β rays. Rutherford was the first to recognise that these two types are relatively unimportant, and that the α rays represent at least 99 per cent. of the total energy radiated. The analysis of the rays from a radio-element into its several parts, the greater part usually coming from the various transition-forms, which can be removed by chemical means, and only a small part from the parent element itself, has borne out this conclusion. For in the majority of cases known α rays are alone expelled in the disintegration. The discovery of the magnetic and electric deviability of the α ray of radium to an extent about one thousand times less, and in the direction opposite to that suffered by the β ray in similar circumstances, enabled Rutherford to settle the question as to their nature by showing them to consist of projected particles carrying a positive charge, about one thousand times the mass of the kathode ray particle and therefore comparable in size to the hydrogen atom, travelling with a velocity about one-tenth that of light.

This discovery has two bearings. On the one hand it confirms in a remarkable manner the view of the nature of electricity adopted by J. J. Thomson as the result of his investigations of the conduction of electricity through gases, that the negative charge can be dissociated from the atom, whereas the positive charge is always associated with a particle of atomic dimensions. On the other, it provided at once a mental picture of the precise change suffered by the atom of a radio-element, which the discovery of thorium X and the investigation of its behaviour had established. To take the case of radium as an example. The α particle expelled is an integral part of the heavy radium atom, which after disintegration forms a new and lighter atom, viz. that of the emanation. This suffers a second disintegration, expelling more α particles and changing into the matter which causes the "excited activity." Owing to the average life of the emanation atom being short—only 5·79 days—its energy is liberated so rapidly that a correspondingly small quantity can be detected. The energy manifestations from the emanation are very surprising, although it is not present in sufficient quantity to be detected by ordinary means.

An interesting feature at the present time arises from the fact that since the α rays given out by a

radium compound are derived from several distinct atoms, the parent radium atom, and the successive products of its disintegration, it is to be expected, as Rutherford has pointed out, that the velocity of the α particles will vary within certain limits. Becquerel, however, states that the α radium rays in his experiments were deflected as a homogeneous pencil. Moreover, according to the same authority, they possess the remarkable property of being the more difficult to deviate for any given strength of field the greater the distance of air traversed. Both these observations seem contrary to what we should expect, and the latter especially is difficult to account for.

With regard to the "spinthariscope" effect of the α ray when it impinges on a zinc-blende screen, discovered by Crookes, it appears probable from the work of Becquerel, Tommasina and others that the scintillations are not caused, as was at first thought, by the direct impact of the individual α particle, but are due to cleavages provoked in the crystals of the blende by the bombardment, each cleavage, rather than each impact, giving rise to a flash of light.

The spontaneous heat evolution of radium to the extent of 100 gram-calories per gram of radium per hour, which was established some months ago by Curie and Laborde by direct calorimetric experiments, although it is the fact about radium which has appealed most strongly to the general imagination, hardly came as a surprise to those who were aware of the other properties of the element. Rutherford and McClung in 1901 estimated the energy radiated from a gram of uranium oxide as at least 0·03 calorie per gram per year, and it was known that this must be increased at least a million times for the case of radium. In addition, the well known chemical actions of the radium rays—the conversion of oxygen into ozone, and the decomposition of water into its elements—showed that their energy must be very considerable. The recent discovery of Rutherford and Barnes that more than 70 per cent. of the energy evolved from radium is due to the insignificant amount of emanation and the products of its further change, less than 30 per cent. being due to the element itself, follows as a direct consequence of the disintegration theory. It furnishes, it would seem, an almost unanswerable argument against the view that the energy evolved from radium is derived from an external source of unknown nature.

The view that radio-activity proceeds independently of temperature, which was originally arrived at by Becquerel by his study of the radiations of uranium, and is now generally recognised, was confirmed by M. Curie last year by some careful measurements of the rate of decay of the penetrating radiation from a sealed glass tube containing the radium emanation. He showed that the rate of the decay was not affected by variations of temperature between 450° C. and −180° C. Since it is the universal experience, not only for variations in temperature, but also for all other agents, that the rate of disintegration is constant and unaffected by molecular forces, it follows that the causes at work which produce disintegration are at present entirely unknown. It appears certain that it cannot be brought about by any agencies with which we are familiar. Sir Oliver Lodge has suggested that the unstable condition results from the incessant radiation of the internal energy of the atom, the latter being a necessary consequence of the electronic theory of atomic structure.

The discovery by Sir William Ramsay and the writer that radium is continuously producing helium in sufficient quantities to be spectroscopically recognised marks a new phase in the development of radio-activity by bringing the problem within the range of the ordinary methods of chemical investigation. From the disintegration theory it followed that the accumulation, during past ages, of the final products of the change of the radio-elements must exist in the natural minerals in which these elements are found. The existence of helium in the radio-active minerals, and its absence from those which do not contain the radio-elements, coupled with the fact that this gas forms no compounds but exists in the minerals "occluded" in a curious and unexplained way, pointed strongly to the view that it had been formed as one of the products of the change of one of the radio-elements during past ages, and mechanically imprisoned within the mineral. This led to the experiments being undertaken. The gradual growth of the helium spectrum in a sealed tube in which the radium emanation was originally condensed by liquid air and all other gases removed by the pump, excludes the view that radium may form a slowly decomposing compound with helium. The amount produced, as theory requires, is excessively minute, and its detection with the small quantity of radium available was due to the extreme delicacy of its spectrum reaction, and to the refined methods of gas manipulation developed by Ramsay in his investigation of the rare gases of the atmosphere. The suggestion that has been made that the α particle is an atom of helium has not yet been experimentally proved.

These direct confirmations of the theoretical predictions show that our knowledge of radio-activity has passed from a purely descriptive basis. The numerous unrelated and inexplicable experimental facts which have accumulated during the seven years the property has been known have during the past year been co-ordinated harmoniously as the effect of a definite and consistent cause. Radio-activity, in consequence, claims to-day to rank as an independent science. It is a property which may be best described as added on. It manifests itself without affecting or being affected by the ordinary chemical and physical nature of the matter in question, and therefore belongs to the domain neither of physics nor of chemistry. There is in consequence reason for considerable satisfaction that the theory of atomic disintegration to which radio-activity has directly led is also in the nature of an addition to, rather than a controversion of, accepted scientific doctrines. Nothing could be further from the truth than the idea that it upsets in any way the atomic theory of chemistry. On the contrary, as the bearing of the conception comes to be more clearly seen, it will probably be recognised that it provides the atomic theory with a measure of confirmation and new evidence which advances it a little further in the direction of that direct experimental proof which we are so frequently being reminded it is impossible for any theory to attain.

FREDERICK SODDY.

OBSERVATIONS OF GLACIERS AND AVALANCHES.[1]

BOTH the pamphlets mentioned below are issued by the Commission Française des Glaciers. The former mainly consists of a study of the glaciers about the head-waters of the Arc, a region which, forty years ago, had been visited only by a few Alpine climbers, who found the official maps far from accurate above the snow line; following this are notes about glaciers of the Grandes Rousses, a snowy ridge

1 "Rapport sur les Observations Glaciaires en Haute-Maurienne, dans les Grandes-Rousses et l'Oisans, dans l'été de 1902." Par M. Paul Girardin. Revue de Glaciologie. No. 2. Année 1902. Par M. Charles Rabot. Pp. 121; illustrated. (Paris: Typographie Philippe Renouard, 1903.)

"Observations sur l'Enneigement et sur les Chutes d'Avalanches, exécutées par l'Administration des Forêts dans les Departements de la Savoie. Pp. 15. (Paris: Au siège du Club Alpin Français, 1903.

between the Maurienne and Dauphiné. In the former region the glaciers are not large, though fairly continuous along the western side of the watershed between France and Italy; the highest peaks just exceeding 12,000 feet, and the passes between them being about 10,000 feet. M. Girardin in his remarks directs attention to a point not always sufficiently remembered, that the size of a glacier depends even more upon the form of its birthplace than the altitude. Of this, Dauphiné, rather to the south of the region noticed by him, affords an excellent example. The western end of the horseshoe of its higher peaks is formed by the Mont de Lans, a tabular mountain mass, which, though mostly well under 11,000 feet high, is clothed with a sheet of névé, terminating in glaciers, more extensive than those of the adjoining Râteau and Meije, which rise some 2000 feet higher. It is incidentally mentioned, and this fact is important, that the climate of Lanslebourg is much wetter than that of Modane, the dominant wind at the latter being W. or N.W., at the former E. or S.E., bringing vapour from the plain of the Po. As the district is so little known, we content ourselves with giving M. Girardin's general conclusions. They are:—(1) the glaciers of this region, after a rapid retreat (since 1860 approximately), have during the last few years either moved back very slowly or even halted; (2) this retreat has changed many of them from valley glaciers to plateau glaciers; (3) sometimes the glacier has gone back as a whole, sometimes it has melted away from the sunny side of a valley, thus changing the form of its terminal boundary, a matter to be remembered in speaking of the "retreat" of a glacier.

This report is followed by the *Revue de Glaciologie*, No. 2, giving a summary of observations about the increase or decrease of glaciers in many parts of the world, made or published in 1902, with occasional mention of earlier changes, and some interesting notes on the level of the snow-line. Evidently, though locally the retreat has been arrested or even changed into an advance, a period of growth has not yet really begun.

The second pamphlet largely consists of tables giving the snowfall and avalanches in parts of the French Alps during the winter of 1899–1900 and the two following years. These will ultimately be very valuable, but at present hardly suffice for drawing inferences. We may, however, mention that in the first period the snowfall in Savoy ranged from 85 mm. at Thonon to 1600 mm. at Sixt. The largest amount recorded is on the Col de Fréjus, in the Maurienne (almost above the great tunnel), the differences probably depending mostly on altitude but to some extent on geographical position. In that year the largest downfall in an hour was 68.6 mm., on this pass and its neighbourhood. The statistics of avalanches are for 1900–1, and for the following season. March is the worst month, then February and April. The falls were much more numerous and mischievous in the second year, during which fifty-six persons were overwhelmed by them, of whom eight perished, as against three in the former year.

JOHN SAMUEL BUDGETT.

BRITISH zoology in general, and the Cambridge School of Zoology in particular, has received a heavy blow in the tragic and untimely death of Mr. J. S. Budgett. It is only a few weeks since the readers of NATURE were informed of the brilliant success attending Mr. Budgett's researches during his last expedition, and zoologists—not of this country alone—were looking forward with the greatest interest to the publication of his full results. It was not to be. On Saturday, January 9, after his usual day's work in the laboratory at Cambridge, he fell ill with blackwater fever, and after a few days' illness he passed away on the morning of January 19, the very day on which he was to have read to the Zoological Society his account of the general results of his last expedition.

Mr. Budgett was born near Bristol thirty-one years ago, and here, at his home, Stoke Bishop, the earlier years of his life were passed. In his father's house Budgett had the great advantage of meeting as friends such men as Dr. W. H. Dallinger and the late Prof. W. K. Parker, and from them he received much inspiration and encouragement. He was particularly influenced by Parker. He possessed copies of Parker's monographs, and he set himself a task which few indeed would have attempted without an elaborate university training, the task of working over the development of the skull in a series of vertebrate types. By the exercise of limitless patience and admirable technical skill—he even designed a perfectly original and remarkably successful mechanical microtome for the cutting of serial sections—he produced a series of beautiful models of developing crania.

Mr. Budgett commenced his academic studies at University College, Bristol, under Lloyd Morgan and Reynolds, and thence passed on to Cambridge and entered Trinity College in 1894. There he went through the routine course of study for the natural sciences tripos—interfered with to some extent, from the point of view of mere academic success, by his accompanying Prof. Graham Kerr on an expedition to South America during 1896–7. On this expedition Budgett devoted himself to gaining a general acquaintance with the neotropical fauna, and also to broadening his knowledge of general morphology by carrying out dissections and making microscopic preparations of many of the more important animals. In addition to this he applied himself especially to the study of the Amphibia, amassing a large amount of information as well as valuable collections of developmental and other material. This material received preliminary treatment in a paper in the *Quarterly Journal of Microscopical Science*, but Budgett intended to work it up later in a comparative paper along with the material collected under similar physical conditions in West Africa.

On this first expedition Budgett's splendid qualities shone out conspicuously—his personal courage, his fortitude and cheerfulness under physical discomfort and suffering, and his absolute loyalty.

Already during his stay in South America Budgett had practically decided to take up the problem of the development of Polypterus, and immediately after graduating at Cambridge he set out with this object in view to the Gambia. Here he spent the greater part of a year in the first instance, returning again for a few months during 1900. During these expeditions Mr. Budgett did not manage to obtain the main object of his quest, but he did succeed in obtaining and preserving with the faultless technique so characteristic of him a mass of most valuable material. The hand of Death has intervened before time had been given for more than preliminary work on this material, but even this preliminary work contains results of much importance to vertebrate zoology—in particular a complete and accurate account of the genito-urinary organs of Polypterus, the demonstration that the crossopterygian fin is really a uniserial archipterygium, and finally a most valuable series of observations on the breeding habits and developmental features of Protopterus and of several interesting teleostean fishes.

Budgett still stuck pertinaciously to the main problem. Having been elected Balfour student, he

started off again in June, 1902, this time to East Africa in the hope of there finding a locality with physical conditions more favourable to the prosecution of his research. Finding, however, that conditions were less rather than more favourable, Mr. Budgett returned down the Nile to England. In June, 1903, he started again for West Africa, and took up his quarters at a point in the Niger delta where he knew Polypterus to be abundant. Here at last he succeeded, by means of artificial fertilisation, in obtaining a fine series of the long wished for eggs and larvæ. He returned to England and settled down to work out his material in the laboratory of his friend and teacher, Mr. Adam Sedgwick, and there he was at work on that fateful Saturday when there came to him the first premonition of impending illness.

Budgett's personality had a peculiar charm. Unassuming, modest to a fault, his diffidence at times brought him moods of severe depression. Latterly, however, he had been cheered and encouraged by the appreciation of his work by those to whom he most looked up.

He was a zoologist of the best type. He was a keen and accomplished observer in the field, and always recognised to the full that the first and main interest in an animal lies in the fact that it is an organism which *lives*. But in addition he was a most accomplished laboratory investigator. With great interest in laboratory technique he combined tireless patience in research and almost fastidious accuracy. His artistic powers were shown in the charming sketches which he brought back from his various expeditions, and they are again apparent in the beautiful preparations with which he enriched the museum at Cambridge.

He has gone, but he has left behind an enduring memorial in the work he has done and in the affectionate memories which will be treasured by his many friends.

NOTES.

Lord Rayleigh has been created a foreign Knight of the Prussian Order Pour le Mérite for sciences and arts by the German Emperor.

The remains of James Smithson, the Englishman who founded the Smithsonian Institution in Washington, reached New York on January 20, having been conveyed from Genoa in the *Prinzessin Irene*. The United States despatch-boat *Dolphin* awaited the arrival of the vessel in order to act as an escort of honour from the lower bay to the city. Smithson's remains were taken to Washington in the *Dolphin*; and on January 25 the transfer of the coffin, draped with the American and British flags, was witnessed by Sir Mortimer Durand, the British Ambassador, Mr. Loomis, Acting Secretary of State, and a number of members of the Senate and House of Representatives. Escorted by a troop of cavalry and a marine band, the remains were conveyed to the Smithsonian Institution, where a suitable tomb will be erected.

Prof. Weismann's seventieth birthday was celebrated in Freiburg on January 17, when a large and representative gathering assembled to do him honour. A bust by Kowazik, of Frankfort, had been subscribed for by biologists in various parts of the world, and was presented in the name of the subscribers by Prof. H. E. Ziegler, of Jena; it is to be placed in the zoological institute of the university. A special number of the *Zoologische Jahrbucher*, containing papers by various naturalists, was presented by Prof. Spengel, of Giessen, and from the Grand Duke of Baden Prof. Weismann received the highest order conferable, that of the Cross and Star of Bertold I. To all interested in the advance of biological science, and more especially to those who know him also as a man of wide culture and high ideals, it will be a satisfaction to learn that Weismann retains unabated his freshness, vigour, and untiring energy.

The President of the Board of Trade has appointed a committee to inquire and report as to the statutory requirements relating to the illuminating power and purity of gas supplied by the metropolitan gas companies, and as to the methods now adopted for testing the same, and whether any alteration is desirable in such requirements or methods, and, if so, whether any consequential alteration should be made in the standard price of gas. The members of the committee are:—Lord Rayleigh, F.R.S. (chairman), Sir William de W. Abney, K.C.B., F.R.S., Dr. Robert Farquharson, M.P., Mr. William King, and Mr. J. Fletcher Moulton, M.P. Mr. Herbert C. Honey, of the Board of Trade, has been appointed secretary to the committee.

We regret to announce that the Rev. Dr. Salmon, F.R.S., Provost of Trinity College, Dublin, since 1888, died on Friday last at eighty-four years of age.

Mr. F. E. Beddard, F.R.S., has been elected a corresponding member of the Königliche Böhmische Gesellschaft de. Wissenschaften.

A Reuter message from New York on January 22 states that the University of California has been informed of the discovery of remarkably fine remains of an ichthyosaurus in Chile.

A despatch from Buenos Ayres announces that the *Français*, with Dr. Charcot's Antarctic Expedition on board, reached Ushuaia, Patagonia, on January 15, and left for the south after coaling.

Dr. Lorenzo Camerano, of the Royal Zoological Museum, Turin, Dr. Fritz Sarasin, and Dr. Paul B. Sarasin, of Basel, have been elected foreign members of the Zoological Society of London.

A Prehistoric Society of France has just been founded at Paris with the object of studying questions of palæo-ethnology. The president for 1904 is M. Émile Rivière, and the monthly meetings are held at 93 Boulevard Saint-Germain.

Mr. W. Saville-Kent has been engaged to investigate and advise towards the further development of the pearl, shell and other fisheries pertaining to certain Polynesian Island properties, and will leave England in a few weeks' time to take up his new appointment.

The death is announced of Prof. Georg Wagner, professor of chemistry in the polytechnic at Warsaw, aged fifty-four.

The Guy medal of the Royal Statistical Society has been presented to M. Yves Guyot for his paper on "The Sugar Industry on the Continent."

The St. Petersburg Physico-Chemical Society has projected a new Arctic expedition to be undertaken for the following objects:—observations of solar radiation and atmospheric refraction, of cloud movements, and of atmospheric electricity in connection with the extinction of ultra-violet light; determination of the phenomena of terrestrial magnetism and of electric currents in the ocean; chemical analyses of the composition of the air and water; and examinations of the polar ice.

We regret to see the announcement of the death of Dr. William Francis, which occurred early last week. Dr. Francis was in his eighty-seventh year, and had been in failing health but a short time. He was almost the oldest, if not the oldest, fellow of the Chemical Society, and was joint editor of the *Annals and Magazine of Natural History* and of the *Philosophical Magazine*. In the latter capacities he came in contact with most of the eminent scientific men of the nineteenth century.

To commemorate the twenty-fifth anniversary of the introduction and commercial development of the incandescent lamp, the friends and associates of Mr. Thomas A. Edison have taken steps to found a medal which will be entrusted to the American Institute of Electrical Engineers. It is proposed to present the medal fund at the annual dinner of the institute on February 11, which is Mr. Edison's birthday.

It is reported from St. Petersburg that on January 16 Dr. Turtchinowitch, director of the laboratory for the preparation of plague remedies at the Imperial Institute of Experimental Medicine, was taken ill after having been engaged in experimenting with bubonic plague cultures, and died of plague on January 20. It has been established that two assistant physicians who were working with Dr. Turtchinowitch have also acquired the disease.

On Thursday next, February 4, Mr. A. D. Hall will deliver the first of three lectures at the Royal Institution on "Recent Research in Agriculture." On Saturday, February 6, Mr. C. Waldstein will lecture on "The Study of Style in Greek Sculpture," and on February 13 his subject will be "Culture and Sculpture." On Saturday, February 20, Lord Rayleigh will begin his course of six lectures on "The Life and Work of Stokes." The Friday evening discourse on February 19 will be delivered by Mr. C. T. R. Wilson on "Condensation Nuclei."

The Tanganyika Committee (Prof. Ray Lankester, Sir John Kirk, Sir W. Thiselton-Dyer, Mr. Boulenger, and Dr. Sclater) has determined to send out another naturalist for the further investigation of the "Tanganyika problem," and has selected Mr. W. A. Cunnington, of Christ's College, Cambridge, for this purpose. Mr. Cunnington will leave for Tanganyika (*viâ* Chinde and Zomba) in March, and will pay special attention to the lacustrine flora of the lake, of which, as yet, little is known, but will not neglect other subjects relating to the lake-basin.

A scientific expedition for the exploration of northern Nigeria, conducted by Lieut. Boyd Alexander and Captain G. B. Gosling, of the Rifle Brigade, is in preparation, and will shortly leave England. Lieut. Claud Alexander, who holds the diploma of the Royal Geographical Society, will act as surveyor and map-maker. The party will proceed up the Niger and Benué, and establish a station somewhere in the central hill-country of northern Nigeria, where collections of natural history will be made, and the surrounding country explored and mapped. Lieut. Boyd Alexander, who has already had much experience in African travel on the Zambezi, in the Gold Coast Colony, and in Fernando Po, is a thoroughly competent man, and has obtained the sanction of the War Office to his expedition.

We regret to see announced the death of Mr. Walter G. Doggett, the naturalist of the Anglo-German Boundary Commission under Major Delmé Radcliffe, who has lost his life while crossing the Kagera River in Uganda. Mr. Doggett, who was the son of a well-known taxidermist at Cambridge, served on Sir Harry Johnston's staff as naturalist and photographer both in Nyasaland and in Uganda, and will be found frequently mentioned in Sir Harry's work on the latter country. Doggett made the ascent of Ruwenzori in the Special Commissioner's company, and amongst many other objects, obtained there specimens of a remarkable new bramble which has been named after him *Rubus Doggetti*. He was the first person to discover the existence of the shoebill (*Balaeniceps rex*) on the shores of Lake Victoria.

It appears from a telegram dated Yakutsk, January 15, and communicated to the Russian Press, that on that date the boatswain Byegacheff, one of the members of Lieut. Kolchak's Expedition which was sent out in search of Baron Toll, returned to Yakutsk. The expedition did not find the Arctic traveller either in the New Siberia Islands or in Bennett Land. It only found in the latter place some papers left by Baron Toll stating that he was leaving Bennett Land on November 8, 1902, and going southwards. He consequently expected to reach the mainland of Siberia somewhere near Nizhne-Kolymsk, but as nothing was heard of Baron Toll during last summer, one cannot but entertain the gravest apprehensions as to his position. Lieut. Kolchak is expected soon to reach Yakutsk, as well as the other search party under Brusneff, so that we shall probably have more detailed news in a few days.

The Royal Society catalogue of scientific papers from 1884 to 1900, completing the century, is making progress. It appears that 111,000 titles have already been prepared by the referees in the various subjects, while 68 serials containing more than 91,000 titles have been completely dealt with for both the authors' catalogue and the subject index. It is part of the scheme to make a single subject index for the whole of the nineteenth century; nearly 82,000 of the 400,000 papers dealt with in the existing catalogue have now been classified for this index. The index will be in seventeen sections, published separately, each section containing, in one or more octavo volumes, a single science indexed according to the schedules of the international catalogue; when published, these volumes cannot fail to be of great use to workers in science. The committee of the Royal Society is making strenuous efforts to expedite the work. Its chief difficulty has been in obtaining a sufficient staff of experts, and attention is invited to its advertisement asking for additional helpers.

The annual general meeting of the Iron and Steel Institute will be held on Thursday and Friday, May 5 and 6. The council will shortly proceed to award Carnegie research scholarships, and candidates must apply before February 29. The awards will be announced at the general meeting. In accordance with previous announcements, the autumn meeting will take place in New York on October 24–26. After the meeting there will be an excursion to Philadelphia, Washington, Pittsburg, Cleveland, Niagara Falls, and Buffalo, returning to New York on November 10. An influential committee has been formed in the United States for the reception of the institute, Mr. Charles Kirchhoff being the president and Mr. Theodore Dwight the hon. secretary.

As the result of a meeting held in London several months ago, a society has been formed for the promotion of scientific studies in sociology. It is hoped that when the Sociological Society becomes adequately organised it will materially help to fill a serious gap in the cultural apparatus for national education and research. One of the founders of the society has given 1000*l.* towards the endowment of

sociological teaching in London University. With that exception there is at present no provision in British universities for studies specifically sociological. This country is also alone among leading nations in having neither a journal of sociological studies nor a special library of sociological literature. In addition to directing attention to these national deficiencies, the Sociological Society is making particular efforts to organise a reference library of sociology and to establish a journal of sociology. Particulars referring to the society's origin, purpose and programme may be obtained by application to the secretary, 5 Old Queen Street, Westminster, S.W.

EARLY in September, 1900, Galveston was devastated by a storm and a great wave which overwhelmed the bank on which the city is built. To prevent the recurrence of this disaster, the whole city—buildings, streets, boulevards, parks, theatres, residences and quays—in fact, everything now resting on the present ground level, are, says *Transport*, to be lifted up 17 feet in the air, and the space between the old and the new levels will be filled in, so that the city will be actually that number of feet higher than it is at present. The cost of this undertaking is estimated to be some three and a half million dollars, and the contract for lifting the city has been awarded to Messrs. Goedhart Brothers, of New York City, in cooperation with Mr. Lindon W. Bates, the engineer who devised the scheme for making Galveston flood-proof.

THE Autocopyist Company has sent us one of its "Black Boxes." This is really a form of small portable changing bag, and should be found useful to every photographer, whether amateur or professional, whilst travelling. The term "box" is rather a misnomer, for it is really not a box at all. The black cloth, forming the dark space, is very ingeniously made to fold up or out by means of two sets of wire frames after the principle of an umbrella, the lower portion having a larger circumference than the upper; when expanded the whole arrangement is placed on a bench or table and is ready for use. There are two sleeves for the insertion of the arms and one for the head, all of which have elastic extremities to fit tight to keep out the light. There is also a small window covered with red cloth, and a separate celluloid red sheet to place over this window. Altogether this portable dark room looks as if it would prove very serviceable, for it is well made, light, and closes up into a small compass.

THE Deutsche Seewarte (Hamburg) has recently made an addition to its useful contributions to maritime meteorology by the publication of a quarterly pilot chart for the North Sea and Baltic. The first issue is for the present winter, and every available space is occupied by valuable information for navigators and others. The mean frequency of wind direction for various parts of the different coasts is shown by wind-stars giving percentages of the observations by lines radiating from a central circle in which is shown the number of calms; the percentage of wind direction for any point of the compass can be easily measured from a given scale. The mean tracks of storms are laid down in the usual way, together with the average minima of barometric pressure. Three subsidiary charts show (1) the mean isobars and prevalent wind direction; (2) the average air temperature; (3) the mean temperature of the sea surface and average prevalence of fog. The reverse side of the chart is occupied by a series of maps showing the tidal currents on the coasts of the British Islands and north-west Europe for each hour following the flood and ebb tides at Dover. In addition to the data exhibited by the charts, the text contains much useful information relating to the prevalence of storms, ice and other matters.

THE Meteorological Office Atlantic pilot chart for February contains an interesting article by Dr. Shaw on "Buys Ballot's Law and Trajectories of Air." Several diagrams are given representing the air movements during the passage across our islands of two cyclonic systems, that of November 12–13, 1901, moving at the rate of 15 miles an hour, attended by hard gales and heavy rain, and that of March 24–25, 1902, moving at the rate of 25 miles an hour, attended by strong winds and gales and but little rain. The circumstances in the two cases differ also in the general disposition of atmospheric pressure and the behaviour of the barometer in the surrounding regions. There is, consequently, a wide divergence in the air trajectories of the two systems. From a consideration of the facts presented we are "led to associate changes of surface velocity with exchange of air between the surface and the upper regions, unless they can be accounted for by alterations of area. Exchanges between the surface and the upper air are connected with temperature change and generally also with rainfall, and thus the vicissitudes of the air along its trajectories may have a very close connection with the special character of the weather changes associated with the passage of depressions." To the mariner the questions raised are of more than passing interest, for the article touches upon the question of ascending and descending air currents, which can be established or verified by the effects produced upon meteorological instruments or upon the surface of the sea. Every sailor has observed how the wind in some storms beats down the sea, while in others it raises a tumultuous sea. There is reason to suppose that in the former case the wind is a descending current, in the latter an ascending current. It is to be hoped that officers will supply careful notes on these different characteristics of wind and sea, as the subject is one of great importance from a meteorological point of view, and up to the present has not been investigated.

AN interesting paper on a familiar subject, the relation of temperature to the keeping property of milk, has reached us from Storrs, Connecticut. The view of the writer, Mr. H. W. Conn, the well-known dairy bacteriologist, is that the keeping of milk is more a matter of temperature than of cleanliness. He points out that at 50° F. milk may not curdle for two weeks, whereas at 70° F. it may keep but forty-eight hours, and at 95° F. but eighteen hours. This curdling is due to the action of bacteria, and the effect of temperature on their multiplication is surprising. Thus at 50° the ordinary milk organisms increase about 5-fold in twenty-four hours, but at 70° they may multiply 750-fold in the same time. The optimum temperature for different species varies considerably. At 70° the ordinary *B. lactis acidi* develops rapidly, while at 95° the undesirable lactic ferment *B. lactis aerogenes* develops quickly and the ordinary form does not. At 50° neither of the lactic ferments makes much growth, but putrefactive bacteria develop, and though these may not make the milk sour, they make it unwholesome. Milk which has been kept sweet by exposure to low temperatures should be viewed with suspicion.

THE fourth report of the Royal Commission on Sewage Disposal, which has just been published, deals with the pollution of tidal waters, with special reference to contamination of shell-fish. The Commissioners state that they are satisfied that a considerable number of cases of

enteric fever and other illness are caused by the consumption of shell-fish which have been exposed to sewage contamination. Of the remedies suggested, the opinion is expressed that no general enactment as to the treatment of sewage before its discharge into tidal waters or as to the seizure of unwholesome food would meet the necessities of the case, but that the remedy must be sought in connection with the waters, foreshores, pits, ponds, and layings themselves. It is considered that the only way in which the evil can be effectively dealt with is by placing tidal waters under the jurisdiction of some competent authority, and conferring on that authority power to prevent the taking of shell-fish for human consumption from any position in which they are liable to risk of dangerous contamination, and to enforce restrictions as regards pollution and as regards the waters, beds, &c., in which shell-fish are fattened or stored. At the end of the report several pages are devoted to a consideration of the bacteriological methods employed in the examination of shell-fish. It is stated that Dr. Houston, the bacteriologist to the Commission, has examined more than 1000 oysters, some taken from the purest waters in the country, and has found that nearly all, from whatever laying, contain the *Bacillus coli*. Doubt is therefore raised as to the value that may attach to the *B. coli* test, and it is considered that further research is necessary in order to establish a bacteriological standard of purity.

IN the December issue of the *Proceedings* of the American Academy (vol. xxxix., No. 10) Mr. F. C. Carlton records the results of experiments with regard to the cause and nature of the periodical colour-change in the skin of the Florida chamæleon-iguana (*Anolis carolinensis*). The extreme variations in the colour of this lizard are dark brown and pea-green, the former (in captive specimens at any rate) assumed in daylight and the latter at night. The brown condition is produced by the migration of pigment-granules from the centre to the terminal branches and processes of the "melanophores," the green stage, which is one of rest, being the result of the withdrawal of the same granules to the centre of the latter bodies. In three fundamental points the colour-change differs from that of the true chamæleons.

THE November (1903) issue of the *American Naturalist* contains the second of the series of articles on the adaptations of mammals to particular modes of life, the present section, by Mr. L. I. Dublin, dealing with arboreal types. With the exception of the Monotremata, all the terrestrial orders have arboreal representatives, the number of such forms being greatest in the Chiroptera (where all adopt this mode of life) and Primates, and least in the Ungulata, where there are only the tree-hyraces. Arboreal mammals may be divided into two main groups, in the first of which terrestrial progression is retained in a greater or less degree, while in the second it is wholly lost. Among the modifications for this kind of life, in addition to those of the feet and tail, the author specially notices the frequent increase of the number of the vertebræ, and the development of dermal spines and scales, as in the Anomaluridæ and Gymnura, which aid in climbing. The inclusion of the latter genus among arboreal mammals appears to indicate some new information in the possession of the author.

THE *Journal* of the Royal Statistical Society for December 31, 1903, contains an important paper on the metric system by Mr. Alexander Siemens, together with a report of the discussion. It is illustrated by tables showing the trade of metrical and non-metrical countries for the year 1900, that year marking a culminating point in most countries. Mr. Siemens puts forward powerful arguments in favour of adopting the metric system, and concludes by saying that "it is quite certain that the action of Great Britain in this matter would immediately be followed by Greater Britain, the United States, and Russia, so that international unity of weights and measures would become an accomplished fact for which James Watt started his agitation 120 years ago."

WE have received the "Naturalist's Directory" for 1904–5 from Mr. L. Upcott Gill, by whom the annual is published. It gives the names and addresses of naturalists, natural history agents, societies, field clubs and museums of the British Isles, and the information has been corrected to the present date.

DR. A. LAWRENCE ROTCH writes to correct the following mistakes made by him in his letter on "The Unusual Sky Colours and the Atmospheric Circulation," published in NATURE of December 24, 1903 (p. 173). In the first paragraph, line twenty-four, for "southern" read "northern," and in the second paragraph, line eight, for "unlike" read "like."

THE new edition of Hazell's "Annual"—that for 1904—is the nineteenth issue of this valuable book of reference. As usual, the alphabetical arrangement is adopted, but this year many of the separate entries of former years have been collected in the form of more complete articles. Thus the information given respecting scientific societies and the advances made in various branches of scientific knowledge during 1903 is brought together in a convenient manner in some thirteen successive pages. A complete index much assists reference to the large amount of statistical and other information given in the volume.

THE Natural History Society of Northumberland, Durham, and Newcastle-upon-Tyne, held a conversazione on January 19 at the Hancock Museum, Newcastle-upon-Tyne. Experimental and lantern demonstrations in a variety of subjects were given during the evening. These and the exhibitions included:—the inactive atmospheric gases; their spectra and some of the apparatus used in determining their physical properties, by Sir William Ramsay; objects illustrating certain properties of the emanations of radium, by Sir William Crookes; the bactericidal emanations from radium, by Mr. Henry Crookes; models of turbine machinery from the Parsons' Marine Steam Turbine Co., Ltd., and many others. The meeting was an excellent indication of the interest in scientific research which exists in this northern district.

IN the *Sitzungsberichte* of the Vienna Academy of Sciences Dr. Langstein gives an account of his researches on the carbohydrates of serum-globulin. The experiments establish the fact that *d*-glucose is one of the primary decomposition products of blood-globulin, and the existence of a close relationship between albumen and glycogen is shown. Reference is made to the possible connection between the observed facts and the abnormal physiological processes taking place in cases of diabetes.

IN a paper entitled "An Enquiry into the Working of Various Water-softeners," read before the Institution of Mechanical Engineers on December 18, 1903, Messrs. Stromeyer and Baron describe and illustrate by means of diagrams seventeen continuous water-softeners. Analyses

of the unsoftened and softened waters are given which permit of a fair comparison being made as to the suitability of the various types for special purposes. Of the seventeen softeners, fourteen are fitted with filters, two of them having sand filters, and the others woodwool, or sponge filters.

WE have received vol. ii. of the *Transactions* of the North Staffordshire Ceramic Society. The Society has a membership of thirty, and seven papers have been read before the members during the session. Of special interest is a paper by Messrs. Hopwood and Jackson on the nature and origin of the abnormal red, blue and black colorations of fire-clay ware. The red colorations are found to be due to the conversion of the iron in the clay substance into free ferric oxide, the black principally to free carbon, whilst the external vitreous blue films of blue-fired clay-wares are found to consist of a basic ferrous silicate.

THE much debated question regarding the dual nature of chromium solutions as manifested in the green and violet colour is again discussed by Messrs. Richards and Bonnet in a recent number of the *Proceedings* of the American Academy. The authors' experiments and previous observations seem to be most easily explainable on the assumption that the violet solutions of, say, chromium sulphate contain the salt in a state comparable to that of other normal salts, whilst the green solutions are due to hydrolysis resulting in the production of free acid and one or more complex basic salts.

IN the quarterly statement of the Palestine Exploration Fund Mr. W. Ackroyd discusses the cause of the saltness of the Dead Sea. Facts are brought forward which seem to indicate that the saltness cannot be entirely due to accumulation of chlorides derived from the Palestine rocks by solvent denudation or the cutting off of an arm of the Red Sea by the rising of Palestine in past ages followed by evaporation of the solution. The author brings evidence forward in favour of a third cause, which is perhaps more important than either, viz. the atmospheric transportation of salt from the Mediterranean.

A THIRD revised edition of part ii. of "Machine Design," by Prof. Forrest R. Jones, of Cornell University, has been published in this country by Messrs. Chapman and Hall. This part of the work deals with the form, strength, and proportions of parts, and the new issue has been increased by about eighty pages of new matter.

THE additions to the Zoological Society's Gardens during the past week include a Vervet Monkey (*Cercopithecus lalandii*) from South Africa, presented by Mrs. Hughes; a White-collared Mangabey (*Cercocebus collaris*) from West Africa, presented by Mr. H. Ion; a Chacma Baboon (*Papio porcarius*) from South Africa, presented by Mr. James Adams; a Levaillant's Cynictis (*Cynictis penicillata*) from South Africa, presented by Lady Constance Ryder; a Spotted Ichneumon (*Herpestes nigropunctatus*) from Nepal, presented by Mr. S. D. Pritchard; two Herring Gulls (*Larus argentatus*), European, presented by Mr. F. H. Haines; a Barn Owl (*Strix flammea*), British, presented by Master C. Fox; a — Sheep (*Ovis* sp. inc) from Baluchistan, two Waxwings (*Ampelis garrulus*), European; a Grey Squirrel (*Sciurus cinereus*) from North America, a Brazilian Tortoise (*Testudo tabulata*) from South America, two Ceylonese Terrapins (*Nicoria trijuga*) from India, two Derbian Sternotheres (*Sternothoerus derbianus*) from West Africa, deposited; a Humboldt's Lagothrix (*Lagothrix humboldti*), a Red-faced Ouakari (*Ouacaria rubicunda*) from the Upper Amazons, purchased.

OUR ASTRONOMICAL COLUMN.

ASTRONOMICAL OCCURRENCES IN FEBRUARY:—

Feb. 1. 12h. Saturn in conjunction with the sun.
4. 8h. 41m. Minimum of Algol (β Persei).
7. 5h. 30m. ,, ,, ,,
8. 6h. 17m. Transit (ingress) of Jupiter's Sat. IV. (Callisto).
9. 15h. Ceres in conjunction with moon. Ceres 0° 8′ N.
,, 21h. Mercury at greatest elongation. 25° 52′ W.
12. 16h. Venus in conjunction with moon. ♀ 4° 8′ S.
14. Venus. Illuminated portion of disc = 0·797.
24. 5h. 57m. to 7h. 15m. Moon occults α Tauri (Aldebaran, Mag. 1·1).
25. 17h. Mercury in conjunction with Saturn. Mercury 0° 49′ S.
,, 17h. Mars in conjunction with Jupiter. Mars 0° 30′ N.
27. 7h. 13m. Minimum of Algol (β Persei).
29. 8h. 53m. to 9h. 46m. Moon occults o Leonis (mag. 3·8).

VARIABILITY OF THE MINOR PLANET IRIS.—A telegram from Prof. Pickering, through the Kiel Centralstelle, announces that Prof. Wendell has discovered a periodic variability in the brightness of the minor planet (7) Iris. The period of the changes is six hours, and the range of variability about one-quarter of a magnitude.

HARVARD MERIDIAN PHOTOMETER OBSERVATIONS.—Part i. vol. xlvi. of the Harvard College Observatory *Annals* contains the tabulated results of the meridian photometer observations made by Prof. Solon. I. Bailey at Arequipa and Cambridge (Mass.) during the years 1899–1902. Chapter i. contains the reduced observations of some 4500 stars situated south of −30° declination made at the southern station during 1899, the stars observed being generally selected from the Argentine General and Cordoba Zone Catalogues.

One of the chapters contains the results of a series of observations made at Cambridge (1900–1902) in order to produce a catalogue of standard stellar magnitudes for regions regularly distributed throughout the sky. To this end the sky was divided into 432 regions, each approximately 10° square, and one star of about the fifth magnitude was photometrically observed in each region, care being taken to select, wherever possible, a star having a first-type spectrum. All the stars were compared with λ Ursæ Minoris and other standard comparison stars, and on reducing the observations it was soon apparent that the results obtained from λ were systematically different from those obtained from the other stars. This difference indicates an increase of two-tenths of a magnitude in the brightness of λ Ursæ Minoris, which may either be due to a personal equation depending on the colour or to a real variation in the star.

LIGHT CHANGES OF ϵ AURIGÆ.—In Nos. 3918, 3919 and 3920 of the *Astronomische Nachrichten* Herr H. Ludendorff publishes the results of an exhaustive research as to the most probable data for the light variation of ϵ Aurigæ.

He first gives and discusses the observational results of Argelander, Heis, Schwab, Plassman, and thirteen other observers, and then, applying suitable weights to the various results, obtains a mean result by the method of least squares. The resulting elements obtained from this analysis are

$$T = 2415476 \text{ days} = \text{April } 1,\ 1901,$$
$$t = 207\text{d.} \quad t_m = 313\text{d.},$$
$$T = 2415840 = \text{March } 31,\ 1902,$$

where T = the epoch at which the light commences to decrease from its normal magnitude, t = the time taken for the complete decrease to minimum or the corresponding increase to maximum, t_0 = the duration of the constant minimum, and T_0 = the epoch of the mean minimum.

Summarising the results the author finds that the star has a normal magnitude of 3·35, decreases 0·73 mag. in 207 days, remains at constant minimum for 313 days, and then returns to the normal magnitude again in 207 days. After these changes it remains constant for 25·13 years. Thus the complete period for this star becomes 27·12 years, or 9905 days, of which only 1·99 years are occupied by the actual variation.

SCIENTIFIC INVESTIGATION AND PROGRESS.[1]

AT the weekly services of many of our churches it is customary to begin with the reading of a verse or two from the Scriptures for the purpose, I suppose, of putting the congregations in the proper state of mind for the exercises which are to follow. It seems to me we may profit by this example, and accordingly I ask your attention to Article i. of the Constitution of the American Association for the Advancement of Science, which reads thus:—"The objects of the association are, by periodical and migratory meetings, to promote intercourse between those who are cultivating science in different parts of America, to give stronger and more general impulse and more systematic direction to scientific research, and to procure for the labours of scientific men increased facilities and a wider usefulness."

The first object mentioned, you will observe, is "to promote intercourse between those who are cultivating science in different parts of America"; the second is "to give a stronger and more general impulse and more systematic direction to scientific research"; and the third is "to procure for the labours of scientific men increased facilities and a wider usefulness." Those who are familiar with the history of the association are well aware that it has served its purposes admirably, and I am inclined to think that those who have been in the habit of attending the meetings will agree that the object which appeals to them most strongly is the promotion of intercourse between those who are cultivating science. Given this intercourse and the other objects will be reached as a necessary consequence, for the intercourse stimulates thought, and thought leads to work, and work leads to wider usefulness.

While in 1848, when the association was organised and the constitution was adopted, there was a fair number of good scientific investigators in this country, it is certain that in the half century that has passed since then the number of investigators has increased very largely, and naturally the amount of scientific work done at present is very much greater than it was at that time. So great has been the increase in scientific activity during recent years that we are apt to think that by comparison scientific research is a new acquisition. In fact there appears to be an impression abroad that in the world at large scientific research is a relatively new thing, for which we of this generation and our immediate predecessors are largely responsible. Only a superficial knowledge of the history of science is necessary, however, to show that the sciences have been developed slowly, and that their beginnings are to be looked for in the very earliest times. Everything seems to point to the conclusion that men have always been engaged in efforts to learn more and more in regard to the world in which they find themselves. Sometimes they have been guided by one motive and sometimes by another, but the one great underlying motive has been the desire to get a clearer and clearer understanding of the universe. But besides this there has been the desire to find means of increasing the comfort and happiness of the human race.

A reference to the history of chemistry will serve to show how these motives have operated side by side. One of the first great incentives for working with chemical things was the thought that it was possible to convert base metals, like lead and copper, into the so-called noble metals, silver and gold. Probably no idea has ever operated as strongly as this upon the minds of men to lead them to undertake chemical experiments. It held control of intellectual men for centuries, and it was not until about a hundred years ago that it lost its hold. It is very doubtful if the purely scientific question whether one form of matter can be transformed into another would have had the power to control the activities of investigators for so long a time, and it is idle to speculate upon this subject. It should, however, be borne in mind that many of those who were engaged in this work were actuated by a desire to put money in their purses—a desire that is by no means to be condemned without reserve, and I mention it not for the purpose of condemning it, but to show that a motive that we sometimes think of as peculiarly modern is among the oldest known to man.

[1] Address by Prof. Ira Remsen, retiring president of the American Association for the Advancement of Science, delivered at St. Louis, December 28, 1903.

When the alchemists were at work upon their problems, another class of chemists was engaged upon problems of an entirely different nature. The fact that substances obtained from various natural sources and others made in the laboratory produce effects of various kinds when taken into the system led to the thought that these substances might be useful in the treatment of disease. Then, further, it was thought that disease itself is a chemical phenomenon. These thoughts, as is evident, furnish strong motives for the investigation of chemical substances, and the science of chemistry owes much to the work of those who were guided by these motives.

And so in each period as a new thought has served as the guide we find that men have been actuated by different motives, and often one and the same worker has been under the influence of mixed motives. Only in a few cases does it appear that the highest motives alone operate. We must take men as we find them, and we may be thankful that on the whole there are so many who are impelled by one motive or another, or by a mixture of motives, to take up the work of investigating the world in which we live. Great progress is being made in consequence, and almost daily we are called upon to wonder at some new and marvellous result of scientific investigation. It is quite impossible to make predictions of value in regard to what is likely to be revealed to us by continued work, but it is safe to believe that in our efforts to discover the secrets of the universe only a beginning has been made. No matter in what direction we may look we are aware of great unexplored territories, and even in those regions in which the greatest advances have been made it is evident that the knowledge gained is almost insignificant as compared with that which remains to be learned. But this line of thought may lead to a condition bordering on hopelessness and despondency, and surely we should avoid this condition, for there is much greater cause for rejoicing than for despair. Our successors will see more and see more clearly than we do, just as we see more and see more clearly than our predecessors. It is our duty to keep the work going without being too anxious to weigh the results on an absolute scale. It must be remembered that the absolute scale is not a very sensitive instrument, and that it requires the results of generations to affect it markedly.

On an occasion of this kind it seems fair to ask the question: What does the world gain by scientific investigation? This question has often been asked and often answered, but each answer differs in some respects from the others, and each may be suggestive and worth giving. The question is a profound one, and no answer that can be given would be satisfactory. In general it may be said that the results of scientific investigation fall under three heads—the material, the intellectual and the ethical.

The material results are the most obvious, and they naturally receive the most attention. The material wants of man are the first to receive consideration. They cannot be neglected. He must have food and clothing, the means of combating disease, the means of transportation, the means of producing heat and a great variety of things that contribute to his bodily comfort and gratify his æsthetic desires. It is not my purpose to attempt to deal with all of these and to show how science is helping to work out the problems suggested. I shall have to content myself by pointing out a few of the more important problems the solution of which depends upon the prosecution of scientific research.

First, the food problem. Whatever views one may hold in regard to that which has come to be called "race suicide," it is certain that the population of the world is increasing rapidly. The desirable places have been occupied. In some parts of the earth there is such a surplus of population that famines occur from time to time, and in other parts epidemics and floods relieve the embarrassment. We may fairly look forward to the time when the whole earth will be overpopulated unless the production of food becomes more scientific than it is now. Here is the field for the work of the agricultural chemist who is showing us how to increase the yield from a given area, and, in case of poor and worn-out soils, how to preserve and increase their fertility. It appears that the methods of cultivating the soil are still comparatively crude, and more and more thorough investigation of the processes involved in the growth of

plants is called for. Much has been learned since Liebig founded the science of agricultural chemistry. It was he who pointed out some of the ways by which it is possible to increase the fertility of a soil. Since the results of his investigations were given to the world the use of artificial fertilisers has become more and more general.

But it is one thing to know that artificial fertilisers are useful and it is quite another thing to get them. At first bone dust and guano were chiefly used. Then as these became dearer, phosphates and potassium salts from the mineral kingdom came into use.

At the Fifth International Congress for Applied Chemistry, held at Berlin, Germany, last June, Dr. Adolph Frank, of Charlottenburg, gave an extremely interesting address on the subject of the use of the nitrogen of the atmosphere for agriculture and the industries, which bears upon the problem that we are dealing with. Plants must have nitrogen. At present this is obtained from the great beds of saltpetre found on the west coast of South America—the so-called Chili saltpetre—and also from the ammonia obtained as a by-product in the distillation of coal, especially in the manufacture of coke. The use of Chili saltpetre for agricultural purposes began about 1860. In 1900 the quantity exported was 1,453,000 tons, and its value was about 60,000,000 dollars. In the same year the world's production of ammonium sulphate was about 500,000 tons, of a value of somewhat more than 20,000,000 dollars. Of these enormous quantities about three-quarters find application in agriculture. The use of these substances, especially of saltpetre, is increasing rapidly. At present it seems that the successful cultivation of the soil is dependent upon the use of nitrates, and the supply of nitrates is limited. Unless something is done we may look forward to the time when the earth, for lack of proper fertilisers, will not be able to produce as much as it now does, and meanwhile the demand for food is increasing. According to the most trustworthy estimations indeed, the saltpetre beds will be exhausted in thirty or forty years. Is there a way out? Dr. Frank shows that there is. In the air there is nitrogen enough for all. The plants can make only a limited use of this directly. For the most part it must be in some form of chemical combination, as, for example, a nitrate or ammonia. The conversion of atmospheric nitrogen into nitric acid would solve the problem, and this is now carried out. But Dr. Frank shows that there is another, perhaps more economical, way of getting the nitrogen into a form suitable for plant food. Calcium carbide can now be made without difficulty, and is made in enormous quantities by the action of a powerful electric current upon a mixture of coal and lime. This substance has the power of absorbing nitrogen from the air, and the product thus formed appears to be capable of giving up its nitrogen to plants, or, in other words, to be a good fertiliser. It is true that this subject requires further investigation, but the results thus far obtained are full of promise. If the outcome should be what we have reason to hope, we may regard the approaching exhaustion of the saltpetre beds with equanimity. But, even without this to pin our faith to, we have the preparation of nitric acid from the nitrogen and oxygen of the air to fall back upon.

While speaking of the food problem, a few words in regard to the artificial preparation of foodstuffs. I am sorry to say that there is not much of promise to report upon in this connection. In spite of the brilliant achievements of chemists in the field of synthesis it remains true that thus far they have not been able to make, except in very small quantities, substances that are useful as foods, and there is absolutely no prospect of this result being reached within a reasonable time. A few years ago Berthelot told us of a dream he had had. This has to do with the results that, according to Berthelot, are to be brought about by the advance of chemistry. The results of investigations already accomplished indicate that, in the future, methods will perhaps be devised for the artificial preparation of food from the water and carbonic acid so abundantly supplied by nature. Agriculture will then become unnecessary, and the landscape will not be disfigured by crops growing in geometrical figures. Water will be obtained from holes three or four miles deep in the earth, and this water will be above the boiling temperature, so that it can be used as a source of energy. It will be obtained in liquid form after it has undergone a process of natural distillation, which will free it from all impurities, including, of course, disease germs. The foods prepared by artificial methods will also be free from microbes, and there will consequently be less disease than at present. Further, the necessity for killing animals for food will no longer exist, and mankind will become gentler and more amenable to higher influences. There is, no doubt, much that is fascinating in this line of thought, but whether it is worth following depends upon the fundamental assumption. Is it at all probable that chemists will ever be able to devise methods for the artificial preparation of foodstuffs? I can only say that to me it does not appear probable in the light of the results thus far obtained. I do not mean to question the probability of the ultimate synthesis of some of those substances that are of value as foods. This has already been accomplished on the small scale, but for the most part the synthetical processes employed have involved the use of substances which themselves are the products of natural processes. Thus, the fats can be made, but the substances from which they are made are generally obtained from nature and are not themselves synthetical products. Emil Fischer has, to be sure, made very small quantities of sugars of different kinds, but the task of building up a sugar from the raw material furnished by nature—that is to say, from carbonic acid and water—presents such difficulties that it may be said to be practically impossible.

When it comes to starch, and the proteids which are the other chief constituents of foodstuffs, the difficulties are still greater. There is not a suggestion of the possibility of making starch artificially, and the same is true of the proteids. In this connection it is, however, interesting to note that Emil Fischer, after his remarkable successes in the sugar group and the uric acid group, is now advancing upon the proteids. I have heard it said that at the beginning of his career he made out a programme for his life work. This included the solution of three great problems. These are the determination of the constitution of uric acid, of the sugars and of the proteids. Two of these problems have been solved. May he be equally successful with the third! Even if he should be able to make a proteid, and show what it is, the problem of the artificial preparation of foodstuffs will not be solved. Indeed, it will hardly be affected.

Although science is not likely, within periods that we may venture to think of, to do away with the necessity of cultivating the soil, it is likely to teach us how to get more out of the soil than we now do, and thus put us in a position to provide for the generations that are to follow us. And this carries with it the thought that, unless scientific investigation is kept up, these coming generations will be unprovided for.

Another way by which the food supply of the world can be increased is by relieving tracts of land that are now used for other purposes than the cultivation of foodstuffs. The most interesting example of this kind is that presented by the cultivation of indigo. There is a large demand for this substance, which is plainly founded upon æsthetic desires of a somewhat rudimentary kind. Whatever the cause may be, the demand exists, and immense tracts of land have been and are still devoted to the cultivation of the indigo plant. Within the past few years scientific investigation has shown that indigo can be made in the factory from substances the production of which does not for the most part involve the cultivation of the soil. In 1900, according to the report of Dr. Brunck, managing director of the Badische Anilin- und Soda-Fabrik, the quantity of indigo produced annually in the factory "would require the cultivation of an area of more than a quarter of a million acres of land (390 square miles) in the home of the indigo plant." Dr. Brunck adds:—"The first impression which this fact may be likely to produce is that the manufacture of indigo will cause a terrible calamity to arise in that country; but, perhaps not. If one recalls to mind that India is periodically afflicted with famine, one ought not, without further consideration, to cast aside the hope that it might be good fortune for that country if the immense areas now devoted to a crop which is subject to many vicissitudes and to violent market changes

were at last to be given over to the raising of breadstuffs and other food products." "For myself," says Dr. Brunck, "I do not assume to be an impartial adviser in this matter, but, nevertheless, I venture to express my conviction that the Government of India will be rendering a very great service if it should support and aid the progress, which will in any case be irresistible, of this impending change in the cultivation of that country, and would support and direct its methodical and rational execution."

The connection between scientific investigation and health is so frequently the subject of discussion that I need not dwell upon it here. The discovery that many diseases are due primarily to the action of microscopic organisms that find their way into the body and produce the changes that reveal themselves in definite symptoms is a direct consequence of the study of the phenomenon of alcoholic fermentation by Pasteur. Everything that throws light upon the nature of the action of these microscopic organisms is of value in dealing with the great problem of combating disease. It has been established in a number of cases that they cause the formation of products that act as poisons, and that the diseases are due to the action of these poisons. So also, as is well known, investigation has shown that antidotes to some of these poisons can be produced, and that by means of these antidotes the diseases can be controlled. But more important than this is the discovery of the way in which diseases are transmitted. With this knowledge it is possible to prevent the diseases. The great fact that the death rate is decreasing stands out prominently and proclaims to humanity the importance of scientific investigation. It is, however, to be noted in this connection that the decrease in the death rate compensates to some extent for the decrease in the birth rate, and that, if an increase in population is a thing to be desired, the investigations in the field of sanitary science are contributing to this result.

The development of the human race is dependent not alone upon a supply of food, but upon a supply of energy in available forms. Heat and mechanical energy are absolutely essential to man. The chief source of the energy that comes into play is fuel. We are primarily dependent upon the coal supply for the continuation of the activities of man. Without this, unless something is to take its place, man is doomed. Statistics in regard to the coal supply and the rate at which it is being used up have so frequently been presented by those who have special knowledge of this subject that I need not trouble you with them now. The only object in referring to it is to show that, unless by means of scientific investigation man is taught new methods of rendering the world's store of energy available for the production of heat and of motion, the age of the human race is measured by the extent of the supply of coal and other forms of fuel. By other forms of fuel I mean, of course, wood and oil. Plainly, as the demand for land for the production of foodstuffs increases, the amount available for the production of wood must decrease, so that wood need not be taken into account for the future. In regard to oil, our knowledge is not sufficient to enable us to make predictions of any value. If one of the theories now held in regard to the source of petroleum should prove to be correct, the world would find much consolation in it. According to this theory petroleum is not likely to be exhausted, for it is constantly being formed by the action of water upon carbides that in all probability exist in practically unlimited quantity in the interior of the earth. If this be true, then the problem of supplying energy may be reduced to one of transportation of oil. But given a supply of oil and, of course, the problem of transportation is solved.

What are the other practical sources of energy? The most important is the fall of water. This is being utilised more and more year by year since the methods of producing electric currents by means of the dynamo have been worked out. There is plainly much to be learned before the energy made available in the immediate neighbourhood of the waterfall can be transported long distances economically, but advances are being made in this line, and already factories that have hitherto been dependent upon coal are making use of the energy derived from waterfalls. The more rapidly these advances take place the less will be the demand for coal, and if there were only enough waterfalls conveniently situated, there would be no difficulty in furnishing all the energy needed by man for heat or for motion.

It is a fortunate thing that, as the population of the earth increases, man's tastes become more complex. If only the simplest tastes prevailed, only the simplest occupations would be called for. But let us not lose time in idle speculations as to the way this primitive condition of things would affect man's progress. As a matter of fact, his tastes are becoming more complex. Things that are not dreamed of in one generation become the necessities of the next generation. Many of these things are the direct results of scientific investigation. No end of examples will suggest themselves. Let me content myself by reference to one that has of late been the subject of much discussion. The development of the artificial dye-stuff industries is extremely instructive in many ways. The development has been the direct result of the scientific investigation of things that seemed to have little, if anything, to do with this world. Many thousands of workmen are now employed, and many millions of dollars are invested, in the manufacture of dye-stuffs that were unknown a few years ago. Here plainly the fundamental fact is the æsthetic desire of man for colours. A colourless world would be unbearable to him. Nature accustoms him to colour in a great variety of combinations, and it becomes a necessity to him. And his desires increase as they are gratified. There seems to be no end to development in this line. At all events, the data at our disposal justify the conclusion that there will be a demand for every dye that combines the qualities of beauty and durability. Thousands of scientifically trained men are engaged in work in the effort to discover new dyes to meet the increasing demands. New industries are springing up and many find employment in them. As a rule the increased demand for labour caused by the establishment of these industries is not offset by the closing up of other industries. Certainly it is true that scientific investigation has created large demands for labour that could hardly find employment without these demands.

The welfare of a nation depends to a large extent upon the success of its industries. In his address as president of the British Association for the Advancement of Science given last summer, Sir Norman Lockyer quotes Mr. Chamberlain thus:—"I do not think it is necessary for me to say anything as to the urgency and necessity of scientific training. . . . It is not too much to say that the existence of this country, as the great commercial nation, depends upon it. . . . It depends very much upon what we are doing now, at the beginning of the twentieth century, whether at its end we shall continue to maintain our supremacy or even equality with our great commercial and manufacturing rivals." In another part of his address Sir Norman Lockyer says:—"Further, I am told that the sum of 24,000,000*l*. is less than half the amount by which Germany is yearly enriched by having improved upon our chemical industries, owing to our lack of scientific training. Many other industries have been attacked in the same way since, but taking this one instance alone, if we had spent this money fifty years ago, when the Prince Consort first called attention to our backwardness, the nation would now be much richer than it is, and would have much less to fear from competition."

But enough on the purely material side. Let us turn to the intellectual results of scientific investigation. This part of our subject might be summed up in a few words. It is so obvious that the intellectual condition of mankind is a direct result of scientific investigation that one hesitates to make the statement. The mind of man cannot carry him much in advance of his knowledge of the facts. Intellectual gains can be made only by discoveries, and discoveries can be made only by investigation. One generation differs from another in the way it looks at the world. A generation that thinks the earth is the centre of the universe differs intellectually from one that has learned the true position of the earth in the solar system, and the general relations of the solar system to other similar systems that make up the universe. A generation that sees in every species of animal and plant evidence of a special creative act differs from one that has recognised the general truth

of the conception of evolution. And so in every department of knowledge the great generalisations that have been reached through the persistent efforts of scientific investigators are the intellectual gains that have resulted. These great generalisations measure the intellectual wealth of mankind. They are the foundations of all profitable thought. While the generalisations of science belong to the world, not all the world takes advantage of its opportunities. Nation differs from nation intellectually as individual differs from individual. It is not, however, the possession of knowledge that makes the efficient individual and the efficient nation. It is well known that an individual may be very learned and at the same time very inefficient. The question is, what use does he make of his knowledge? When we speak of intellectual results of scientific investigation, we mean not only accumulated knowledge, but the way in which this knowledge is invested. A man who simply accumulates money and does not see to it that this money is carefully invested is a miser, and no large results can come from his efforts. While, then, the intellectual state of a nation is measured partly by the extent to which it has taken possession of the generalisations that belong to the world, it is also measured by the extent to which the methods by which knowledge is accumulated have been brought into requisition and have become a part of the equipment of the people of that nation. The intellectual progress of a nation depends upon the adoption of scientific methods in dealing with intellectual problems. The scientific method is applicable to all kinds of intellectual problems. We need it in every department of activity. I have sometimes wondered what the result would be if the scientific method could be employed in all the manifold problems connected with the management of a Government. Questions of tariff, of finance, of international relations would be dealt with much more satisfactorily than at present if the spirit of the scientific method were breathed into those who are called upon to deal with these questions. It is plain, I think, that the higher the intellectual state of a nation the better will it deal with all the problems that present themselves. As the intellectual state is a direct result of scientific investigation, it is clear that the nation that adopts the scientific method will in the end outrank both intellectually and industrially the nation that does not.

What are the ethical results of scientific investigation? No one can tell. There is one thought that in this connection I should like to impress upon you. The fundamental characteristic of the scientific method is honesty. In dealing with any question science asks no favours. The sole object is to learn the truth, and to be guided by the truth. Absolute accuracy, absolute fidelity, absolute honesty are the prime conditions of scientific progress. I believe that the constant use of the scientific method must in the end leave its impress upon him who uses it. The results will not be satisfactory in all cases, but the tendency will be in the right direction. A life spent in accordance with scientific teachings would be of a high order. It would practically conform to the teachings of the highest types of religion. The motives would be different, but so far as conduct is concerned the results would be practically identical. I need not enlarge upon this subject. Unfortunately, abstract truth and knowledge of facts and of the conclusions to be drawn from them do not at present furnish a sufficient basis for right living in the case of the great majority of mankind, and science cannot now, and I do not believe it ever can, take the place of religion in some form. When the feeling that the two are antagonistic wears away, as it is wearing away, it will no doubt be seen that one supplements the other, in so far as they have to do with the conduct of man.

What are we doing in this country to encourage scientific investigation? Not until about a quarter of a century ago can it be said that it met with any encouragement. Since then there has been a great change. Up to that time research was sporadic. Soon after it became almost epidemic. The direct cause of the change was the establishing of courses in our universities for the training of investigators somewhat upon the lines followed in the German universities. In these courses the carrying out of an investigation plays an important part. This is, in fact, the culmination of the course. At first there were not many following these courses, but it was not long before there was a demand for the products. Those who could present evidence that they had followed such courses were generally given the preference. This was especially true in the case of appointments in the colleges, some colleges even going so far as to decline to appoint anyone who had not taken the degree of doctor of philosophy, which is the badge of the course that involves investigation. As the demand for those who had received this training increased, the number of those seeking it increased at least in the same proportion. New universities were established and old ones caught the spirit of the new movement until from one end of the country to the other centres of scientific activity are now found, and the amount of research work that is done is enormous compared with what was done twenty-five or thirty years ago. Many of those who get a taste of the work of investigation become fascinated by it and are anxious to devote their lives to it. At present, with the facilities for such work available, it seems probable that most of those who have a strong desire and the necessary industry and ability to follow it find their opportunity somewhere. There is little danger of our losing a genius or even one with fair talent. The world is on the lookout for them. The demand for those who can do good research work is greater than the supply. To be sure the rewards are not as a rule so great as those that are likely to be won by the ablest members of some other professions and occupations, and so long as this condition of affairs continues to exist there will not be so many men of the highest intellectual order engaged in this work as we should like to see. On the other hand, when we consider the great progress that has been made during the last twenty-five years or so, we have every reason to take a cheerful view of the future. If as much progress should be made in the next quarter century, we shall, to say the least, be able to compete with the foremost nations of the world in scientific investigation. In my opinion this progress is largely dependent upon the development of our universities. Without the opportunities for training in the methods of scientific investigation there will be but few investigators. It is necessary to have a large number in order that the principle of selection may operate. In this line of work as in others, many are called, but few are chosen.

Another fact that is working advantageously to increase the amount of scientific research done in this country is the support given by the Government in its different scientific bureaus. The Geological Survey, the Department of Agriculture, the Coast and Geodetic Survey, the National Bureau of Standards and other departments are carrying on a large amount of excellent scientific work, and thus helping most efficiently to spread the scientific spirit throughout the land.

Finally, two exceedingly interesting experiments in the way of encouraging scientific investigation are now attracting the attention of the world. I mean, of course, the Carnegie Institution, with its endowment of 10,000,000 dollars, and the Rockefeller Institute, devoted to investigations in the field of medicine, which will no doubt be adequately endowed. It is too early to express an opinion in regard to the influence of these great foundations upon the progress of scientific investigation. As both will make possible the carrying out of many investigations that would otherwise probably not be carried out, the chances of achieving valuable results will be increased. The danger is that those who are responsible for the management of the funds will be disappointed that the results are not at once of a striking character, and that they will be tempted to change the method of applying the money before those who are using it have had a fair chance. But we who are on the outside know little of the plans of those who are inside. All signs indicate that they are making an earnest effort to solve an exceedingly difficult problem, and all who have the opportunity should do everything in their power to aid them.

In the changes which have been brought about in the condition of science in this country since 1848, it is safe to say that this association has either directly or indirectly played a leading part. It is certain that for the labours of scientific men increased facilities and a wider usefulness have been procured.

FIREBALLS IN JANUARY.

APART from the rich shower directed from the region of Bode's asterism Quadrans, or northern limits of Boötes, on the opening nights of January, the meteors visible in this month have usually attracted little attention. Observers who have watched the cold winter sky have, indeed, generally remarked a scarcity of meteors amongst the beautiful constellations displayed at this season of the year. Zezioli, it is true, was more successful in the clear atmosphere of Italy, for on the closing nights of January, 1868, he saw a plentiful swarm of shooting stars falling from Corona and Ursa Major, and one or two other observers have occasionally recorded meteoric activity of somewhat special character, but, with the exception of its New Year's shower, the month commonly furnishes us neither with any plentiful displays nor with an abundance of meteors giving evidence of a multitude of attenuated streams.

But in recent years January has certainly shown itself rather noteworthy on account of the brilliant fireballs which have appeared. This month in 1901, 1903 and 1904 proved rich in these startling visitors. About ten were seen in 1901, five were well observed and their real paths computed in 1903, and seven appeared between January 8–22, 1904. We must also remember the great fireballs of 1894 January 25, 1898 January 21, and the pair which were quite conspicuous in bright sunshine on the early afternoons of 1900 January 9 and 1901 January 6 respectively.

A comparison of the various dates shows that the apparitions have marked two periods of the month, viz.

January 6 to 15, and
January 23 to 29.

In future years it will be desirable to watch for fireballs at these special epochs. No particular shower appears to have been responsible for their production in past years. The radiant points seem to have been widely separated, and prove that our brilliant January meteors have little if any community of origin, but may rather be regarded as isolated cosmic rovers. If they individually represent meteoric showers, such showers must form the relicts of rich, old-time systems now thinned out beyond visible recognition by frequent *rencontres* with the planets.

It is characteristic of many vividly luminous fireballs that they have very slow, long and nearly horizontal flights. Their average heights are about 67 miles at first, and they disappear either at about 40 or 29 miles. Their radiant-points are usually not far from the horizon, and placed in unusual westerly positions where no ordinary radiants of shooting stars are ever detected. In 1903 very brilliant meteors were seen on January 10, 13, 14, 25 and 28, and in 1904 on January 8, 9, 10, 13, 15, 18 and 22. The one alluded to in NATURE for January 14 as seen by Mr. W. E. Rolston at Fulham on January 9, 8h. 27m., was also observed by Mr. G. F. Oldham at Tunbridge Wells, moving from $110° + 36°$ to $128° + 37°$ in four seconds. The real height of the object during its luminous career was from 60 to 41 miles over the east coast of Kent (Folkestone to Ramsgate), radiant point at $41° + 5°$, and velocity certainly not more, and very probably less, than 6 miles per second. There was another fireball on the following night, Sunday, January 10, at 8h. 32m., observed at Oxford and Llanelly. It descended from a radiant in the east region of Aries over Monmouthshire from a height of 67 to 31 miles. Yet another fireball was recorded on January 15 at Bridgwater and Banbury. It fell from a height of 63 to 27 miles from a radiant near the zenith in the region bordering Perseus and Auriga.

It is fortunate to have secured duplicate observations of these fine objects, and more of them may be expected to appear before the close of the month.

In February fireballs have often been seen on the 3rd, 7th and 10th. These dates will nearly correspond with February 5, 9 and 12 in 1904. There is also a pretty rich shower of meteors from near Capella sometimes observed between February 7 and 23.

W. F. DENNING.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

PROF. EDUARD STUDY, of Greifswald, has been appointed to the chair of mathematics at Bonn in succession to the late Prof. Lipschütz.

ON Thursday, February 11, Prof. Armstrong will give an address at the Battersea Polytechnic on "The Placing of 'Domestics' on a Scientific Practical Basis."

CORNELL University will, says *Science*, receive more than 40,000*l.* from the estate of the late Mr. F. W. Guiteau, of Irvington-on-the-Hudson, which is nearly 10,000*l.* more than was announced at the time of Mr. Guiteau's death last year. The money will be used as a fund for the assistance of needy students, and will be lent them without interest.

DR. GEORG SCHROETER has been appointed professor of organic chemistry in the University of Bonn; Mr. F. Kreutzberg, of Düsseldorf, has been appointed professor of applied mathematics at the new Academy of Posen; Dr. Leo Marchlewski, professor of chemistry at Cracow; Mr. L. Farny, professor in the Zürich Polytechnic; Dr. W. Kötz, professor of chemistry at Göttingen; and Dr. Erich Müller, professor in the chemical department of the Dresden High School.

A PETITION, which it is intended to present to the central educational authorities of the United Kingdom, is being circulated for signature among the registered medical men of the British Isles. The petition directs attention to the serious physical and moral conditions of degeneracy and disease resulting from the neglect and infraction of the elementary laws of hygiene, and urges the central authorities for education to consider whether it would not be possible to include in primary and secondary schools such teaching as may lead all children duly to appreciate healthful bodily conditions. The petition then reviews the steps taken in this direction by English-speaking nations, and shows that great prominence is given in many British colonies to instruction in the laws of health, and concludes by urging the necessity of ensuring that the training of all teachers shall include adequate instruction in these subjects.

AT the annual meeting of the Mathematical Association held on January 23, Prof. A. R. Forsyth, the president, who occupied the chair, in referring to the report of the Committee on the Teaching of Elementary Mathematics, said that in the various stages of the consideration of changes in the regulations at Cambridge University the report of the association proved to be of substantial value. The most interesting event outside the association was the production of the report of the syndicate at Cambridge and the discussion of that report. Some slight modifications were introduced into it, and then it was adopted by the University of Cambridge without a single dissentient. Therefore there had come a change not indeed in teaching, but in the conditions under which teaching could be carried on. If the first working of the regulations was carried out in the spirit in which they were proposed, if the teachers would take the advantage that was offered by the greater ease of the regulations, he thought a substantial improvement would come in the mathematical teaching of the country. Mr. E. M. Langley exhibited models of regular and semi-regular solids, including the four *polyèdres étoiles* of Poinsot. Mr. C. S. Jackson read an account of a recent discussion on the possibility of fusion of the teaching of mathematics and science. Mr. J. C. Palmer dealt with a geometrical note, and Mr. C. A. Rumsey read a paper on advanced school courses of mathematics.

IN the course of an address at the Mansion House on Monday, at the distribution of prizes to the successful students of the City and Guilds Institute, Sir William White remarked that as regards higher technical education we were as a nation in a critical condition. What was wanted was coordination of educational agencies on a carefully considered plan. There must be conference between teachers and the representatives of the professions, businesses, and manufactures if the best results were to be obtained. He was extremely hopeful of the results which would follow the work of an advisory committee at the Institution of Civil Engineers containing re-

presentatives of all the great engineering associations in this country, the duty of which it would be to report as to the best mode of training British engineers in the future. We had at present no proper system of secondary education preparing students for entering technical institutes. In this respect the Germans had certainly stolen a march upon us. We should cease arguing for ever whether the classical side or the modern side of education was the best. The simple solution was that they should go on side by side. There should be a more generous recognition by employers of the necessity and value of the services of trained men. It was a sad thing to know that some of the researches originally made in this country had been first turned to practical account abroad. He knew one case where British manufacturers were to this day paying large royalties in connection with a process of steel manufacture which was actually initiated in England. He looked forward to a system of technical education in London and throughout the country which would show the world that England was still the leader in industry and in resource.

SOCIETIES AND ACADEMIES.

LONDON.

Mathematical Society, January 14.—Dr. E. W. Hobson, vice-president, in the chair.—The following papers were communicated:—Various systems of piling: Prof. J. D. **Everett.** The method of "steps" for dealing with the structure of piles of equal spheres is applied to various arrangements which are of especial interest in crystallography.—The notion of lines of curvature in the theory of surfaces: Dr. G. **Prasad.** The object of the paper is to investigate conditions under which certain known theorems in the theory of surfaces can be extended to the case in which the coordinates of points on the surface are defined by non-analytical functions. The theorems in question are:—(1) The only surface of constant positive curvature is a sphere; (2) no surface of constant negative curvature with continuously varying tangent plane can extend to infinite distances.—Electric radiation from conductors: H. M. **Macdonald.** It is shown that in general, when electrical oscillations on a conductor are taking place, no surface can be drawn to cut the lines of electric force at right angles and to be everywhere close to the surface of the conductor. If such a surface could be drawn there would be no decay of the oscillations by radiation. It is shown that surfaces can be drawn to have the property in question everywhere except near the nodal points of the oscillation, and it is concluded that the radiation takes place mainly in the neighbourhood of the nodes. It is pointed out further that the ordinary theory of electrical waves along wires involves an invalid limiting operation, by which the wires are treated as indefinitely thin and the electric force is taken, nevertheless, to be everywhere at right angles to the wires; and the correction of the ordinary theory required to avoid this operation is discussed.—Groups of the order $p^\alpha q^\beta$: Prof. W. **Burnside.** By a consideration of certain properties of the group-characteristics of groups of the orders in question, it is shown that all these groups are soluble.—The solution of partial differential equations by means of definite integrals: H. **Bateman.** The paper deals with various generalisations of the known solutions of Laplace's equation by means of definite integrals.—Open sets and the theory of content: Dr. W. H. **Young.** Two definitions of the content of an open set are given, and are shown to be in agreement for that class of open sets which has the property that the content of the set, obtained by adding to any member of the class any set of non-overlapping intervals, is equal to the sum of the contents of the component sets. This class contains all known open sets, and all those obtainable from them by any of the ordinary processes.—Upper and lower integration: Dr. W. H. **Young.** All functions, whether integrable or not, possess upper integrals and lower integrals. The problem of determining them is reduced in the paper to that of ordinary integration. It is shown that an upper n-ple integral of a discontinuous function can be expressed in terms of $\int I dk$, where I is the content of the set of points at which the maximum of the function is not less than k, and the integral is taken between suitable limits.—List of primes of the form $4n+1$ between 10^8 and 10^8+10^5: Dr. T. B. **Sprague.**

PARIS.

Academy of Sciences, January 18.—M. Mascart in the chair.—The application of the general theory of the flow of sheets of water infiltrated in the soil to large springs of permeable strata, and, in particular, to several of those supplying Paris: J. **Boussinesq.** The mathematical theory previously worked out by the author has been applied to the three sources of Dhuis, Cérilly, and Armentières. It is found that for important springs in permeable ground the basin of supply is considerably extended downwards below its edge.—On the first numbers of the photographic catalogue of the sky published by M. Trépied: M. **Lœwy.**—On the dispersion of the n-rays and on their wave-length: R. **Blondlot.** The dispersion was studied by means of aluminium prisms and lenses, and it was recognised that the radiation was separated into eight bundles, the refractive indices of which varied from 1·04 to 1·85. The wave-lengths were determined by two methods: by a diffraction grating and by the formation of Newton's rings. The results of the two methods were concordant within the limits of experimental error, the wave-lengths determined proving to be much shorter than those of light. These radiations would appear to be different from the rays of very short wave-length discovered by M. Schumann, inasmuch as the latter are strongly absorbed by air and the n-rays are not.—On the peroxides of zinc: M. **de Forcrand.** A discussion of the results of M. Kuriloff with regard to the formula of peroxide of zinc.—On a characteristic property of the families of Lamy: Alphonse **Demoulin.**—On the *genre* of the derivative of an entire function and on the exceptional case of M. Picard: A. **Wiman.**—The action of radium bromide on the electrical resistance of bismuth: R. **Paillot.** The radiations emitted by radium bromide diminish the electrical resistance of bismuth. The action is practically instantaneous, rapidly falling off with the distance of the radium tube from the bismuth and vanishing when this distance amounts to 1 cm.—On a self-recording differential speed measurer: J. **Richard.**—The influence of the physical nature of the anode on the constitution of electrolytic peroxide of lead: A. **Hollard.** If the lead were deposited as the dioxide, the analytical factor would be 0·866 to convert the dioxide into lead. Experiments with an anode of roughened platinum gave a factor of 0·853, this being independent of the amount of lead in solution.—The chemical nature of colloidal solutions: Jacques **Duclaux.**—A method of separating alumina and iron by the use of formic acid: A. **Leclère.** A modification of the hyposulphite of sodium method, in which the aluminium is separated as the basic formate.—The estimation of chlorates, bromates, and iodates: Léon **Débourdeaux.**—The preparation of primary alcohols by means of the corresponding amides: L. **Bouveault** and G. **Blanc.** The higher fatty amides, reduced by sodium in boiling ethyl alcoholic solution, give yields of from 25 to 30 per cent. of the theoretical. Normal hexyl, normal nonyl, and phenylethyl alcohols were prepared in this way.—The synthesis of sugars, starting from trioxymethylene and sulphite of soda: A. **Seyewetz** and M. **Gibello.**—A new method of synthesis of tertiary alcohols by means of organomagnesium compounds: V. **Grignard.** The magnesium compound R.MgX is converted into $R.CO_2.MgX$ by the action of carbon dioxide, and this is then treated with an additional molecule of R′.MgX, the object being to prepare the ketone R.CO.R′. The reaction was found, however, to result in the production of the tertiary alcohol $R.R'_2.OH$. The new alcohols prepared by this method include diethylisoamyl carbinol, isobutyldiisoamyl carbinol, and phenyldiethyl carbinol.—The influence of radium rays on the development and growth of the lower fungi: J. **Dauphin.** The radium rays arrest the growth of the mycelium of Mortierella, but the spores and mycelium are not killed, but are in a latent state, and, replaced under normal conditions, can germinate and continue to grow.—Researches on the transpiration of the leaves of Eucalyptus: Ed. **Griffon.** In opposition to the views generally expressed, it is found that the leaves of Eucalyptus have not an unusually large transpiratory capacity com-

pared with other leaves. The effects of the growth of this tree in marshy soil are more probably due to its power of rapidly producing a large mass of foliage than to any specially large transpiratory effects.—The utilisation of entomophytic fungi for the destruction of larvæ: C. **Vaney** and A. **Conte.**—On the excrescences of the leaves of the vine: P. **Viala** and P. **Pacottet.** These abnormalities are not observed in vineyards, but are produced by forced culture under glass.—On a trachyte in the French Soudan: H. **Arsandaux.** The case described is the first example of volcanic rock in the western French Soudan. Two types of alkaline trachyte and one basalt were found.—The increase of useful work in traction by the use of elastic apparatus: MM. **Ferrus** and **Machart.**—Remarks by M. **Marey** on the preceding paper.—The relation between the appearance of secondary sexual characters and the interstitial testicular gland: P. **Ancel** and P. **Bouin.**—The action of various substances on the glycogeny of the liver: MM. **Doyon** and **Kareff.**—The determination of the value of intraorganic combustion in the parotid gland of the ox in a state of activity and repose: G. **Moussu** and J. **Tissot.**—On the stimulation of nerves by discharges of condensers: M. **Cluzet.**—On certain congenital anomalies of the head, determining a symmetrical transformation of the four extremities (acrometagenesis): V. **Babès.**—On the destruction of the winter egg of Phylloxera: G. **Cantin.**

DIARY OF SOCIETIES.

THURSDAY, JANUARY 28.

ROYAL SOCIETY, at 4.30.—Observations on the Sex of Mice—Preliminary Paper: Dr. S. M. Copeman, F.R.S., and F. G. Parsons.—Observations upon the Acquirement of Secondary Sexual Characters indicating the Formation of an Internal Secretion by the Testicle: S. G. Shattock and C. G. Seligmann.—On the Part played by Benzene in Poisoning by Coal Gas: Dr. R. Staehelin.—On the Islets of Langerhaus in the Pancreas: H. H. Dale.—The Morphology of the Retrocalcarine Region of the Cortex Cerebri: Prof. G. Elliot Smith.

ROYAL INSTITUTION, at 5.—The Flora of the Ocean: G. R. M. Murray, F.R.S.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—The Edison Accumulator for Automobiles: W. Hibbert. (Adjourned discussion.) To be opened by Dr. J. A. Fleming, F.R.S.—On the Magnetic Dispersion in Induction Motors, and its Influence on the Design of these Machines: Dr. H. Behn-Eschenburg. (Adjourned discussion.)

FRIDAY, JANUARY 29.

ROYAL INSTITUTION, at 9.—The Marshes of the Nile Delta: D. G. Hogarth.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Metallurgy as Applied in Engineering: Archibald B. Head

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—Extra Meeting. Sixth Report to the Alloys Research Committee on the Heat Treatment of Steel: the late Sir William C. Roberts-Austen, K.C.B., F.R.S.. Completed by Prof. W. Gowland. (Continued discussion.)

SATURDAY, JANUARY 30.

ROYAL INSTITUTION, at 3.—British Folk Song: J. A. Fuller-Maitland.

ESSEX FIELD CLUB, at 6.30 (Essex Museum of Natural History, Stratford).—Evidences of Prehistoric Man in West Kent: J. Russell Larkby.—Recent Observations concerning London City Walls, the Walbrooke and Moorfields: F. W. Reader.

MONDAY, FEBRUARY 1.

SOCIETY OF CHEMICAL INDUSTRY, at 8.—A Résumé of the Report, Minutes of Evidence, and Appendices of the Royal Commission on Arsenical Poisoning: Julian L. Baker.

SOCIETY OF ARTS, at 8.—Oils and Fats—their Uses and Applications: Dr. J. Lewkowitsch (Cantor Lectures II.).

ARISTOTELIAN SOCIETY, at 8.—Reality: Shadworth H. Hodgson.

TUESDAY, FEBRUARY 2

ROYAL INSTITUTION, at 5.—The Development of Animals: Prof. L. C. Miall, F.R.S.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Sanding-up of Tidal Harbours: A. E. Carey. (Discussion).—Tonnage Laws and the Assessment of Harbour Dues and Charges: H. H. West.

MINERALOGICAL SOCIETY, at 8.—On a New Sulphostannite of Lead from Bolivia, and its Relations with Franckeite and Cylindrite: G. T. Prior.—On the Gnomonic Net: Harold Hilton.

ZOOLOGICAL SOCIETY, at 8.30.—On the Subspecies of *Giraffa camelopardalis*: R. Lydekker, F.R.S.—On a Collection of Mammals from Namaqualand: Oldfield Thomas, F.R.S.—On the Arteries of the Base of the Brain in Certain Mammals: F. E. Beddard, F.R.S.

FARADAY SOCIETY, at 8.—Notes on Aluminium Welding: Sherard Cowper-Coles.—Some Applications of the Theory of Electrolysis to the Separation of Metals from One Another: A. Hollard.

WEDNESDAY, FEBRUARY 3.

SOCIETY OF ARTS, at 8.—Steam Cars for Public Service: Thomas Clarkson.

GEOLOGICAL SOCIETY, at 8.—The Rhætic Beds of the South Wales Direct Line: Prof. S. H. Reynolds and A. Vaughan. On a Deep-Sea Deposit from an Artesian Boring at Kilacheri, near Madras: Prof. H. Narayana Rau.

ENTOMOLOGICAL SOCIETY, at 8.—On the Habits of some Mantidæ: Captain C. E. Williams.—Systematic Observations upon the Dermatoptera: Malcolm Burr.—Descriptions of New Species of Cryptinæ, from the Khasia Hills, Assam; and a New Species of Bembex: Peter Cameron.—On a New Species of Heterogynis: Dr. T. A. Chapman.—On some New or Imperfectly Known Forms of South African Butterflies: Roland Trimen, F.R.S.

SOCIETY OF PUBLIC ANALYSTS, at 8.—Annual Meeting, followed by Note on the Quantitative Estimation of Mechanical Wood Pulp in Paper: C. F. Cross and E. J. Bevan.—Note on Chinese Tallow Seed Oil: L. Myddelton Nash.—Note on the Analysis of Jam: Raymond Ross.

THURSDAY, FEBRUARY 4.

ROYAL SOCIETY, at 4.30.—*Probable Papers:* The Reduction Division in Ferns: R. Gregory.—Cultural Experiments with "Biologic Forms" of the Erysiphaceæ: E. S. Salmon.—On the Origin of Parasitism in Fungi: George Massee.—On Mechanical and Electrical Response in Plants: Prof. J. C. Bose.—On the Effects of Joining the Cervical Sympathetic Nerve with the Chorda Tympani: Prof. J. N. Langley, F.R.S., and Dr. H. K. Anderson.

ROYAL INSTITUTION, at 5.—Recent Research in Agriculture: A. D. Hall.

CHEMICAL SOCIETY, at 8.—The Tautomeric Character of the Acidic Thiocyanates—Preliminary Note: R. E. Doran.—The Resolution of $\alpha\beta$-Dihydroxybutyric Acid into its Optically Active Constituents: R. S. Morrell and E. K. Hanson.

LINNEAN SOCIETY, at 8.—Account of Researches in the Physiology of Yeast: Prof. Sydney H. Vines, F.R.S.—Further Researches on the Specialisation of Parasitism in the Erysiphaceæ: E. S. Salmon.

RÖNTGEN SOCIETY, at 8.30.—Discussion on the Production of Photographic Reversal through the Action of Various Radiations.

SATURDAY, FEBRUARY 6.

ROYAL INSTITUTION, at 3.—Study of Style in Greek Sculpture: Dr. C. Waldstein.

CONTENTS.

THURSDAY, FEBRUARY 4, 1904.

AFRICAN GAME.

Big Game Shooting and Travel in South-East Africa. By F. R. N. Findlay. Pp. xii+313. (London: T. Fisher Unwin, 1903.) Price 15*s.* net.

THERE is a great deal of interest to the zoologist and botanist in Mr. Findlay's book on his experiences as a hunter in Portuguese South-East Africa and in Zululand. The area visited by this sportsman in Portuguese East Africa was the country in the basin of the Pungwe River (to the north-west of Beira). His journeys in this direction extended northwards to the verge of the Cheringoma Forest, which is not many days' journey south of the Lower Zambesi. This country is very similar in appearance to the lowlands of British Central Africa, that is to say, it is quite tropical, and is without any aridity or absence of vegetation. The wild Hyphæne and date palms are excellently illustrated by the author's photographs, so also are the huge baobab trees. A very good idea of the woodland of these countries (a tangle of wild date palms, acacias, and timber trees of evergreen foliage) is given on p. 75. The Hyphæne (*H. crinita*) appears in many photographs, noteworthy among which are those on pp. 27, 38, and 106. The palms given on pp. 105, 107, and in one or two other illustrations are probably the *Borassus flabellifer*; like so many other palms of this group, they have a bulge in the central portion of their lofty stem. A fine specimen of a baobab tree is given on p. 83.

Besides the many chapters on sport, there is one on game-preserving and on the possibility of domesticating and training African beasts. The author puts in a plea that further attempts should be made to domesticate the African elephant. Probably all the readers of NATURE would be agreed that every effort should be made—must be made—to prevent the extermination of this biggest of living land mammals, but the question of its domestication and usefulness to man is a very doubtful one. It is relatively easy to obtain young African elephants and to tame them in a few days or a few weeks. It is also easy to train them to bear burdens on their backs or to perform other simple tasks, but it cannot be said as they grow up that they evince the same docility that is characteristic of the Indian elephant, while after the males have reached maturity they are positively dangerous. Something might be done with the adult female African elephant. The Romans certainly exported the African elephant (which in Roman times still inhabited parts of Mauritania) to Rome for the sports of the circus and for wild beast shows, but it is much more probable that the war elephants of the Carthaginians were derived from India by way of Syria. Still, the experiment with the African elephant has never been properly tried, and is worth trying, though of necessity something like half a century must elapse before its results can be considered conclusive, owing to the slow rate of growth of the elephant. This calculation is based on the assumption that supplies of domesticated African elephants will only be obtained by catching the young animal between one and two years old, and rearing it in captivity. Of course, if it were possible to work the keddah system and capture and tame the adult animal, a very few years would decide the practicability of the plan.

There is a good deal said about the hippo in this book which is worth reading. The author describes the present condition of the hippopotamus in Zululand, where it still lingers in some of the rivers. He affirms that the white rhinoceros is still existing in Zululand between the forks of the White and Black Umvulosi Rivers, where it will soon, probably, be exterminated completely by colonists from Natal; for, as the author points out, the European natives and settlers of South Africa—the true Afrikanders—are utterly pitiless regarding the wild game, and take no interest whatever in the idea of its preservation, the only exceptions to the rule being the late Mr. Rhodes and one or two enlightened men of Dutch descent, whose herds of gnu and eland have very probably been destroyed during the recent South African war. The absolute extirpation of the magnificent fauna of South Africa, mainly at the hands of British sportsmen and colonists (though the Boers made a good second) will probably remain to all time an ineffaceable stain on the reputation of the Anglo-Saxon—a racial designation which as accurately includes the Dutch as the English. Of course, it was not to be expected that these vast herds of game would be left in sole possession of a country which is adapted in many respects for the white man's habitation, but it is inconceivable that South African and Imperial statesmen could during the whole of the nineteenth century have been so utterly without an appreciation of zoology as to have made no provision in the establishment of reserves for the retention of a fauna whch made South Africa one of the most interesting countries in the world. It is true that some fifty years ago a plea was put in for the preservation of the lion in the Orange Free State, but this was so that the lions might prey on the immense herds of gnus and zebras which were devouring all the grass. One inducement to exterminate the antelopes, zebras, and quaggas lay in the value of their hides, which at one time formed an important article of export from Cape Colony. In 1860, when the late Duke of Saxe-Coburg visited the present Orange River Colony, a big hunt was organised. A thousand natives assisted in driving the game, and it was computed that something like 25,000 antelopes, zebras, and ostriches were driven before the Prince and his staff, and that the battue, in which many Europeans and natives took part, resulted in the slaughter of more than 6000 head of game. The story is much the same throughout our self-governing colonies—Canada, Australia, New Zealand, British Guiana, and Fiji take no heed of the local fauna, and witness its extirpation with apathy, if not with a kind of foolish triumph over nature, while with childish assiduity they attempt to domesticate the birds and beasts of Europe.

Though the writer of this book preaches so effectually in the cause of saving what still remains of

the South African fauna, and offers excellent suggestions for the purpose, he is nevertheless somewhat in the position of Satan reproving sin. He appears to have spared but little in the way of buffaloes, antelopes, zebras, or hippopotami that came in his way, and his beautiful photographs—over and over again—of his trophies make one wince at the shocking and needless extirpation of creatures more wonderful or beautiful, in their physical aspect, than their destroyer. A typical instance of this may be seen in the illustration on p. 227, and it must be borne in mind that this collection of trophies refers to the already sorely diminished game of Zululand.

An interesting chapter contributed to the book by Mr. Cronwright Schreiner deals with the marvellous migrations of the springbuck, which until recently used to pour down at intervals from the northern regions (Bechuanaland and Transvaal) over the more settled districts of South Africa. These movements, Mr. Schreiner thinks, are due to drought in the hinterland forcing the springbuck to move in enormous numbers in search of fresh pasture. Mr. Schreiner himself computes the number that he saw in 1896 in one of these extraordinary migrations at 500,000. An excellent photograph is given of these migratory springbuck on the trek. Of course, on these occasions, the creatures were so massed together that flight from human beings, leopards, or lions was impossible. There have even been occasions when men on foot, overtaken by one of these surging crowds of antelopes, have been knocked down and trampled to death. Mr. Findlay puts in a very strong and valid plea for a gigantic zoological gardens to be created by the State at Pretoria, taking advantage of its genial climate, its abundant water supply, and the fact that so much of the local vegetation is of a semi-tropical character.

The book under review is well worth reading, and will be of permanent value as recording some excellent pictures of the South African buffalo, a form which, owing to the ravages of rinderpest and the attacks of sportsmen, is not very far off extinction.

H. H. Johnston.

ENGINEERING SCIENCE.

Engineering Standards Committee. No. 3. Report on the Influence of Gauge, Length and Section of Test Bar on the Percentage of Elongation. By Prof. W. C. Unwin, F.R.S. Pp. 21, and 2 diagrams. (London: Crosby Lockwood and Son.) Price 2*s.* 6*d.* net.

Technical Mechanics. By Prof. E. R. Maurer. Pp. xvi+382. (New York: John Wiley and Sons; London: Chapman and Hall, Ltd., 1903.) Price 7*s.* net.

THE first of the volumes under notice is one of the reports published by the Engineering Standards Committee, which is doing such valuable work at the present time, and deals with the very important question of the proper dimensions for test bars in order that the percentages of elongation in different sets of experiments can be compared with one another. The report is written by Prof. Unwin, F.R.S., who carried out a series of original investigations for the committee in order that they might have definite experimental data before coming to any decision as to the proportions they would recommend for test bars.

A brief historical summary of our knowledge on this question from the first enunciation of Barba's law in 1880 up to the present is first given, and then the author describes in detail his own series of experiments on ship and boiler steel plates. In the body of the report are given summary tables of the results obtained, and in the appendices full details of the various tests, while the results are shown graphically in the diagrams appended to the report. It was clearly shown by one series of the tests that serious errors are introduced in comparing the ductility of bars when the width of the cross section is kept constant, and therefore the cross sectional area is allowed to vary.

In discussing the rules which might be laid down for standard sizes of test bars, the author points out the grave practical difficulties which arise in either varying the gauge length so as to keep the ratio $l/\sqrt{a}$ constant, or in keeping both gauge length and cross sectional area constant. He suggests that the best plan, from a scientific point of view, would be to keep to a gauge length of 8 inches, and a cross sectional area not exceeding 1 square inch for all plates from $\frac{3}{8}$ inch to $\frac{7}{8}$ inch in thickness, such plates constituting the great bulk of those tested for commercial purposes. As an alternative it might be advisable to specify a fixed gauge length of 8 inches and a width of test bar not to exceed 2 inches for plates lying between $\frac{3}{8}$ inch and $\frac{7}{8}$ inch in thickness, and then to draw up special rules for plates lying outside these limits of thickness. The author, it might be pointed out, has lately given a much more complete account of this piece of research work in a paper read before the Institution of Civil Engineers on November 10 last.

If the various reports of the Standard Committee are all carried out on the lines of those issued up to the present, they will prove of the utmost value to engineers and to the engineering trade of the country.

Prof. Maurer's volume is a text-book on theoretical mechanics for engineering students, the subjects treated having in all cases a direct bearing on engineering problems. It is divided into three sections—statics, kinematics, and kinetics—treated in the order in which they are given.

In dealing with statics, the author adopts freely both graphical and analytical methods, and we strongly approve of this plan, as it has always appeared to us most unwise to divorce these two methods of treatment of statical problems; if properly handled together they greatly assist the beginner in overcoming some of the notorious stumbling-blocks in this branch of mechanics. A particularly useful chapter in this section, both for teacher and student, is vi., in which a series of practical problems involving the application of the principles of equilibrium (worked out in earlier chapters) are dealt with both graphically and algebraically; the examples cover such cases as flexible cords in tackles, jointed frames, and friction in screws, pin joints, belts, &c.

Kinematics is treated mainly from the point of view

of its application in the third section on kinetics, but special attention is devoted to harmonic motion, a matter of great importance to engineers engaged in the design of valve gears, and the investigation of the valve motion due to any type of gear. In the introductory chapter to kinetics, the author discusses fully the difficulties due to the two systems of units adopted in dealing with "mass"; he realises that the gravitation system, or so-called "engineer's system," is not likely to be displaced in spite of the constant endeavours of reformers; it is, in fact, too convenient and enters too constantly into the ordinary engineer's everyday work to be lightly given up. He suggests a name for it—the gee-pound or the gee-kilogram—but we are afraid such names are never likely to be adopted generally; the present method of explaining it as the "engineer" unit is sufficient for all practical purposes, and the names suggested seem to us only to add to the existing confusion. This section is an exceedingly good one; the practical applications are well chosen, such as inertia of reciprocating parts in engines, vibration of springs, moments of inertia of solids of revolution, governors, balancing of rotating bodies, friction of pivots, &c.

In a series of appendices the author treats briefly of vectors, rates, dimensions of units and second moments of areas. The book will be useful to the private student of engineering who is striving to get clear ideas of the fundamental principles on which so much of his work is based, and will probably be adopted in many technical colleges as one of the standard text-books on mechanics. T. H. B.

THE GROWTH OF A FEDERAL EMPIRE.

Geographic Influences in American History. By Albert Perry Brigham, A.M., F.G.S.A., Professor of Geology in Colgate University. Pp. xii + 366. (Boston, U.S.A., and London: Ginn and Co., 1903.) Price 6s.

PROF. BRIGHAM, already known to geologists by a concise and clearly written text-book, here makes an appeal to the historian and the geographer. He does not start with generalisations as to the arrival of the first men on the American continent, or as to its situation between the two ends of the Old World; but he brings us at once to the adventures of Columbus, of Cartier, and then of the English settlers, who found Spaniards south of them and Frenchmen to the north, and who thereupon colonised the central seaboard. "America," in this compact treatise, is wisely limited to the United States, with so much of Canada as is inevitably mingled with their history. The style is direct and even vigorous; in Prof. Brigham's crisp sentences there is a continual mental stimulus, and it would be hard to find a redundant word. We do not like the poetry that is quoted in the book, for the benefit of the general reader, half so much as the author's own admirable prose.

The rise of New York is traced to the formation of the Erie Canal in 1825, whereby the grain of the central plains was brought through the Mohawk gap and floated down the Hudson. The Appalachians have long proved hard to traverse further south, the railways, some of them quite recent, crossing the range at heights of about two thousand feet. The story of the decay of agriculture in New England (p. 47) throws a somewhat melancholy light on the competition between east and west. The author (p. 64) believes that the decay is temporary, and that much of the farm-land in the east will relapse into beneficial forests. The possibility of a balance of mutual utility between districts one or two thousand miles apart affords a pleasant contrast with our tariff-bound Disunited States of Europe. When, however, Prof. Brigham asserts that North America was meant to be owned by one great nation, we think that he is reasoning backwards from the feelings of the present day. A strong Spanish race might long have held the west, a strong French federal republic might conceivably have occupied the plains, and a chain of custom-houses might have existed in the twentieth century on the rim of the Alleghany plateau. We suffer daily in the Old World from violations of geographical propriety, which far surpass anything that would have arisen from such a partition of America.

Prof. Brigham is, however, always willing to lay a proper stress on human enterprise and human individuality. The eastern States became divided (p. 75) as much by differences of "breeding" and ancestral habit as by geography; and the men whose modes of thought allowed them to work hard with their hands have naturally come best out of the struggle.

We have some suspicion that the author prefers Pittsburg to the blue-grass meadows of Kentucky, even when he pictures so charmingly (p. 102) the primitive backwoodsmen, brought up amid a "stable environment in a remote region." After all, the development of machinery has been the making of American agriculture, and it may be difficult, in such a country, to perceive that the growth of cities beyond a certain size and standard is as inimical to social development as is actual isolation in the fields. In the Old World we have so many interests, unconcerned with material prosperity, that we view the growth of Glasgow or Duluth (p. 137) with concern rather than exultation. There is plenty of romance, however, in the story of the capture of the French area on the Mississippi (p. 147) from its English overlords, and abundant cause for national fervour in the map given opposite p. 314, showing the progressive expansion of the United States. The most striking feature, perhaps, in this graphic epitome is the extent of the Louisiana territory, obtained by purchase from Spain in 1803, and stretching west from the Mississippi to the head-waters of the Missouri.

"The West," says Prof. Brigham (p. 308), "is the cosmopolitan part of America. A thousand miles is a short excursion, and across the continent is not an undertaking. Men who could not change their horizon without homesickness did not go west; they are independent of distance, they are accustomed to looking up to find their mountains, and their children are born into their wide, free life."

After remarking that the Pacific coast will "in coming days be commercially independent of the

East," our author endeavours, in chapter xi., to build up a theory of permanent unity on the commingling of diverse races in every portion of the union. But will the ethnographic product of these races, when immigration has been stopped by law, necessarily remain the same under all this variety of geographical conditions? If Sergi, to quote an extremist, is correct, the widespread Mediterranean race has already blossomed out into many "nations," with aspirations and rivalries of their own. It may hereafter be no loss to the great continent that diverse States, united in a federal peace, shall rival one another in an equal diversity of arts, an equal diversity of mental attitudes. Observers in Europe, who recognise the individual insight of the Latins, and the collective solidarity of the Slavs, may not regret, with Prof. Brigham (p. 329), "the decline of the Teutonic stream," and the growth of these two elements. England would be a poor country if the Teutonic stream had dominated her thought, and France owes her laws and manners to the Latins, and much of her early solidity to the Burgundian savages whom she absorbed upon the east. "The pervasive leaven of our American land and our Americanism" may be trusted to adapt the crudest strangers to their new geographical environment. If America has overcome the spirit of Cotton Mather, she will overcome the exuberance of a few Italian bandits, and the depression of the Poles, who are still seeking for a fatherland.

In conclusion, Prof. Brigham's book, allowing for some expressions in American, would be an admirable one for the higher classes of our schools. Read with a good map, and with reference to histories and encyclopædias during hours of preparation, it would provide our youth with a fine lesson in federal expansion, to lay beside those absorbed from, let us say, the intensities of Rudyard Kipling.

Grenville A. J. Cole.

OUR BOOK SHELF.

A New Theory of Organic Evolution. By James W. Barclay (of Glenbuchat). Pp. vi + 174. (Edinburgh and London: William Blackwood and Sons, 1903.) Price 3*s.* 6*d.* net.

The purpose of this work, in the words of its author, is "to test by the common-sense that Huxley says is science, whether the Darwinian doctrine, that the evolution of life (*sic*) on our planet was brought about by natural selection and other secondary causes, accords with ascertained facts, or satisfactorily accounts for the natural phenomena it professes to explain, and, also, to submit a new theory that will explain satisfactorily the admitted facts of evolution." Mr. Barclay's fitness for the task he has undertaken may be judged by the following particulars. In a chapter on "Phases of the Embryo and Fragmentary Organs," he speaks of "the transformation of gills, visible at an early stage in the embryo of mammals, into lungs." In a subsequent chapter he asks, with reference to the whales, "Is it possible to conceive that transformations so great one pair of legs into fins and the other pair into a tail—could have been brought about by natural selection, accumulation of beneficial differences, use or disuse, or changed conditions of existence? How, then, does Darwin's theory explain these changes?" We confess that we are not prepared with an answer to this question; probably, however, the author here intends his words to bear some other than their obvious meaning. When we find, a little further on, a reference to "Professor Weissman in his 'Germinal,'" it is easy to form a conjecture as to the author and treatise intended; but one may be pardoned for not at once recognising the co-discoverer with Darwin of natural selection under the designation of "Mr. Alexander Wallace." The author's "new theory" is simply the outworn hypothesis of special creation in a peculiarly irrational form.

No one thinks of editing a classical text without some knowledge of the language. But it seems that there are persons who are quite ready to publish their views on evolution without having mastered the alphabet of the subject. F. A. D.

Guide du Calculateur. (Astronomie, Géodésie, Navigation, &c.) By J. Boccardi, Privat-docent à l'Université, Chef de Service à l'Observatoire de Catane. Part i., pp. x + 78; part ii., pp. viii + 147. (Paris: A. Hermann; Catane (Italie): J. Pastore.)

The author takes for his motto a sentence of Liagre, "Les plus grands géomètres de l'Allemagne, Gauss, Jacobi, Encke, Bessel, &c., n'ont pas dédaigné de descendre dans de minutieux détails de calcul." Part i. deals with rules for calculations in general, degree of exactitude necessary, choice of tables, discussion of various tables of logarithms, the use of Gauss's sum and difference logarithms, tables of squares, quarter squares, &c. It also deals with practical hints to computers, the use of graphic methods and the slide-rule, and points out the desirability of commencing addition and subtraction at the left. Chapter viii. ends with the excellent piece of advice, "Enfin, c'est une règle générale de ne pas se presser." The last chapter treats of the detection of errors. Part i. may be confidently recommended to all computers. Part ii. commences with remarks and exercises on interpolation, then follow examples of the method of least squares, astronomical calculations of frequent occurrence, the ephemeris, determination of an orbit from three observations, parabolic orbits, correction of an orbit by differential coefficients, and perturbations. The bulk of this part thus appeals to the astronomer. The last chapter describes some geodetic problems, but they are mainly not of a type used by British geodesists.

C. F. C.

Penrose's Pictorial Annual. The Process Year-book, 1903–4. Edited by William Gamble. (London: A. W. Penrose and Co.)

Once again it must be said that there is nothing but praise to be bestowed on the present issue, the ninth, of this beautifully got up volume. Paper, printing, letterpress, illustrations, cover and binding are all alike in excellence, and it seems difficult to conceive how the book could in any way be improved.

The editor, however, is not of the same opinion, for, speaking of the standard of process work, he says "we do not consider it is by any means so high as it might be." We learn from him, further, that "the methods by which these processes are worked are by no means the most exact, nor the most careful, and process work is yet but a young industry, which has hardly yet shaken off the trammels of haphazard experiment and rule of thumb work which must necessarily precede the settled conditions of sound practice based on good theory."

It is gratifying, therefore, to know that higher things may yet be attained, but nevertheless he who wishes to make himself acquainted with the present

state of process work will be astonished at the wealth and efficiency of methods that are at his service as shown by the admirable specimens which are included in this volume.

The present issue is considerably larger than its predecessors, both the articles and illustrations being more numerous; greater prominence is given also to the work of various technical schools and institutions.

Enough, perhaps, has been said to indicate the value of this book, which so beautifully portrays the present stage of advancement in process work.

Geometrie der Dynamen. By E. Study. Two vols. Pp. xiii+603. (Leipzig: B. G. Teubner, 1901 and 1903.)

THE title of this book is somewhat misleading. The object of the first two parts is the discussion of certain geometrical theorems. From these the laws for the composition of wrenches (Dynamen) can be deduced as particular cases. To this special application, from which the book takes its title, only pp. 116 to 121 are devoted. In the first part of the book the geometrical theorems (which deal chiefly with the composition of vectors, wedges, motors, &c.) are proved by purely geometrical methods, and the reader is assumed to have only a good working acquaintance with pure geometry, and in particular a knowledge of the theory of the composition of screws and translations (such as is supplied, for instance, in Schoenflies's "Krystallsysteme und Krystallstructur," pp. 326 to 340). In the second part the analytical proofs of the same geometrical theorems are given, but the author still confines himself to elementary methods. The third part, which contains the larger portion of the book, appeals to a more advanced class of readers who are familiar with the method of modern analysis and the theory of groups. Here the author seeks to supplement the work of Plücker, Ball, and Sturm, and to give a complete discussion and classification of linear line-complexes. A good index and table of contents are given in the second volume. H. H.

The Schoolmaster's Yearbook and Directory, 1904. Pp. lx+1030. (London: Swan Sonnenschein and Co., Ltd., 1904.) Price 5s. net.

THIS is the second annual issue of a very useful publication. It is, what on the title-page it professes to be, a reference book of secondary education in England and Wales. The book consists of two parts; the first contains general information and the second comprises lists of secondary schools for boys and of the masters who teach in them. The general information would have been more useful and more easily accessible had it been considerably condensed; for the essential matter in works of reference is to have the important facts clearly presented with a minimum of description. The "Yearbook" is, however, sure to be widely used, and deserves the popularity it has secured.

Junior Country Reader. I. True Animal Stories. By H. B. M. Buchanan, B.A., and R. R. C. Gregory. Pp. vi+121. (London: Macmillan and Co., Ltd., 1903.) Price 1s.

THESE tales, told in very simple language, are sure to please children of seven or eight years of age. The stories are founded on fact—some of them upon observations recorded from time to time in NATURE. The illustrations, from photographs by Mr. Charles Reid, are numerous and good. The book should serve excellently to awaken in children an interest in animal life.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Destructive Action of Radium.

IT may interest some to know that radium destroys vegetable matter. I happened to replace the usual mica plates, used to keep in the small quantity of radium in its ebonite box, with a piece of cambric, so as to permit the whole of the emanations to pass out, mica stopping the α rays.

In four days the cambric was rotted away. I have replaced it now several times with the same result.

BLYTHSWOOD.

Blythswood, Renfrew, N.B., February 1.

Phosphorescence of Photographic Plates.

WITH reference to letters in NATURE of January 28 and preceding numbers, on "Phosphorescence of Photographic Plates," it seems to be not out of place to direct the attention of those interested in the subject to *Wiedemann's Annalen* of 1888, vol. xxxiv. There will be found, on pp. 918–925, information which may prove of use in further investigation. P. LENARD.

Kiel, January 31.

The French Academy.

WHAT Mr. J. Y. Buchanan says (p. 293) about the French Academy is to me much more wonderful than the revelations of radium. It appears that there is a happy land close by where a scientific man of recognised standing can indulge in the luxury of original research, and then send in an account of his work, *not* to have it rejected by the opinion of, say, a couple of fellow-men, but actually to have it published as a right! This seems impossible. It is the encouragement of original research. Perhaps it is hopeless to expect such freedom in this stick-in-the-mud country, which is so much in love with tradition and antiquated forms. Without any desire to be "contumelious," I would say that our Royal Society reminds me of the House of Lords in many respects. OLIVER HEAVISIDE.

January 31.

Ambidexterity.

IN certain schools, notably, for instance, in Mr. Liberty Tadd's art schools in Philadelphia, children are taught to become ambidextrous, at least to a considerable extent. The advantages of this plan have seemed to be evident, but Mr. Wm. Hawley Smith, the well-known writer on educational topics, has lately (*School and Home Education,* March and October, 1903) argued against it. In a letter just received from him, his views are concisely summed up as follows:—"My notion is, that it is not worth while to try to make *all* our children ambidextrous. I believe that it is *far* wiser to follow nature's lead, with each individual child, and develop them in the use of their hands as they naturally wish to use them. . . . I am sure that, in most cases, we shall fail to secure real skill with *either* hand if we strive to train *both* to do the same work." Mr. Smith further argues that it is hard enough to train one hand to do the more complicated kinds of work, and that it does not pay to waste energy trying to accomplish the more difficult feat of training both. Of course the validity of this argument depends largely upon the assumption that the lack of coordination ordinarily seen in adults is inherent, and not the result of acquired habit, or not largely so. It is perhaps allowable to suggest that this point has not yet been fully decided. It is also a question whether the relative inability of one hand is correlated with an inefficiency of the opposite side of the brain, or putting it another way, whether the extra muscular activity necessary to train two hands instead of one involves a similar increase in mental activity.

There is, however, a third possible plan to follow. While I am in nearly all respects right-handed, I draw with my

left hand, and have always done so from earliest childhood. Without being able to prove it, I have believed that this specialisation of the hands was advantageous. With my right hand I cannot draw at all, nor can I write with my left, except, of course, as anyone can, very badly. If it is a fact that to train the left hand for special purposes, such as drawing, is advantageous, this is worth knowing. Its theoretical explanation would agree very well with the views of Mr. Smith, and it seems to me that there is enough probability in the idea to make it worth following up. Perhaps some of your readers may be able to throw light upon it. T. D. A. COCKERELL.

Colorado Springs, Colo., U.S.A., January 13.

Science at Oxford and Cambridge.

It is very surprising to find Prof. Perry charging Oxford with fearing and hating natural science.

Nearly thirty years ago I was engaged in a cave research which involved geology, zoology, and archæology, as bearing on the cave, its fauna, and objects of human workmanship. One of my colleagues was Mr. W. Bruce Clarke, and I derived valuable assistance from Prof. Boyd Dawkins. Both these gentlemen took first classes in natural science at Oxford. Some years afterwards I investigated the dentition of Aplysiæ. This work was subsequently taken up and completed by another Oxford man, Mr. Walter Garstang. I had been myself much assisted by the Rev. T. R. R. Stebbing, F.R.S., formerly tutor of Worcester College, Oxford.

So far as Cambridge is concerned, in two other subjects I took up, viz. sea-waves and petrology, there was no need to go outside the university, and I may say that the greatest authority on the dentition of gastropods is the Rev. Prof. H. M. Gwatkin, who cannot be persuaded to publish a line on the subject, to the very serious loss to science.

From what I can observe the training of both Oxford and Cambridge is so excellent that the better men are fit to do first-rate work in almost any branch of natural science. As I have said, Prof. Gwatkin is the authority on the dentition of gastropods, while the author of the treatise on molluscs, in the "Cambridge Natural History," is the Rev. A. H. Cooke, a senior classic.

Then we find a senior wrangler, who was not a chemist, setting up a laboratory at home and discovering argon. Then again, we had that wonderful professor of mathematics, the late Sir G. G. Stokes, illuminating every physical subject he approached. I had two correspondences with that illustrious worker, in one of which he conducted me to the very edge of the known, and concluded with the sentence (referring to a paper), "You will be able to judge how far what you have observed may be additional to what is there given." I think that is the distinction between Cambridge research and much modern work. The latter is greatly a matter of text-books and the opinions of authorities. The Cambridge man has conducted you to the absolute front before you know where you are, and there he leaves you to work alone. That has happened to myself repeatedly. The modern school is a little apt to give and take opinions. It is as hard to get an opinion out of a typical Cambridge man as a direct answer from a Quaker. Cambridge has no use for opinions. A. R. HUNT.

Curious Shadow Effect.

IN connection with the "Curious Shadow Effect" mentioned by your correspondent, Mr. H. M. Warner (NATURE, January 28, p. 296), may I be permitted to direct your attention, and his, to a somewhat peculiar "species" of Brocken which I attempted to describe some years ago in the *Scottish Mountaineering Club Journal* (vol. ii. pp. 32–33, 1893)? I ask this, not with any idea of replying to Mr. Warner's inquiry, but to ask another question which perhaps may be answered at the same time. Referring to the above mentioned note, I ask the question, "How was it that more than one image was visible to each of our party?" "Standing close together, all five or six images were visible, all within the wide outer halo; but of course, not one of us saw more than one set of concentric rainbow bands or circles—R.O.Y.G.B.I.V.—and at the lower limbs of the halos nothing of our reflections could be seen, because we were standing slightly *below* the dip of the ridge."

The time of day was between 11 a.m. and noon, and the date was November 24, 1903. In Mr. Warner's case the date was still nearer to mid-winter, and the time of day "near setting" (*i.e.* "within an hour of setting"), and therefore considerably after noon, as shown in the sketch of position. How are the rays affected by refraction and reflection?

I have never seen nor heard of a quite similar Brocken, so I named him "The Brocken of Tarduff" (Hill in Stirlingshire). JOHN A. HARVIE BROWN.

Dunipace, Larbert, Stirlingshire, N.B., January 29.

Subjective Images.

IN corroboration of Prof. Herbert McLeod's observation (p. 297) as to the bright red appearance of printing when the eyes were exposed to the glare of a white chalk road, will you allow me to record an effect I have several times seen when walking over snow while facing bright sunlight? On such occasions every dark object on the snow, and even the shadows in small deep depressions in the snow, have all appeared to me of a vivid blood-red colour.

As to an allied point, I should be glad to be allowed to ask whether the experience of other observers coincides with my own as to the tint of objects seen when the eyes are unequally illuminated. If one eye, right or left, is in full light, and the other shaded (the hand will give shadow enough), then, by closing the eyes alternately, I always find that the field of vision of the shaded eye is of a distinctly warmer tint than that of the eye in full light. If, as Sir Michael Foster says, both eyes respond equally to a stimulus applied only to one, then the explanation which naturally suggests itself, that the difference in the tint of the light seen is in some way dependent on the differing expansion or constriction of the two pupils, becomes inadmissible.

Kew, January 30. E. HUBBARD.

Use of the Kinematograph for Scientific Purposes.

BY means of the kinematograph it is possible to show to the eye the whole course of a visible phenomenon, either at the rate at which it actually happened or at any faster or slower rate that may be desired.

Already it has been made use of to exhibit many phenomena the actual rate of happening of which is too rapid to admit of direct visual perception, as in the case of sound waves and the flight of bullets, but there would seem to be as great possibilities of useful application to render the progress of *slow* motions perceptible. For example, the changes in a cloudy sky are usually so gradual that it is difficult even for a close observer to form a definite mental picture of what has happened in the upper air during, say, a few minutes or a few hours. This difficulty is due not merely to the slowness of the changes, but to their complexity. But suppose that under favourable conditions a good cloud-scape could be photographed, say, 500 times in an hour, and the results put through a kinematograph in one minute, it could hardly fail to help the meteorologist to get a clearer idea of what really happens above us, especially as for purposes of study the *same* phenomenon could be made to pass before the eyes of the student as often as he might desire. Perhaps our meteorological observatories may carry this method far.

Again, suppose a similar application made to the growth or flowering of a plant. I imagine that few botanists have the patience and power of concentration that would be required to get as clear and definite an idea of such a process by direct observation as one could easily acquire by the aid of the kinematograph, and even supposing a botanist possessed a perfect mental grasp of the process, if he wished to describe it to an audience would he not find the kinematographic representation of it an invaluable aid?

No doubt many other possibilities will suggest themselves at once to the reader. R. F. M.

OBSERVATIONS ON THE NATURE OF CANCEROUS GROWTHS.

MUCH of the advance made within recent years in our knowledge of the nature of disease can fairly be traced to the general recognition of the principle that pathological problems can be resolved in the first instance into cell problems. Not only is the modern practice of aseptic surgery founded on this principle, but it also forms the basis of rational as opposed to merely empirical therapeutics.

It is not, however, always easy to interpret the evidence drawn from a study of the cells, for though they may be described as the units of bodily organisation they are themselves extremely complex. Thus it happens that the explanation of this or that series of phenomena is often reached by a roundabout route.

Amongst the diseases in which the cellular aspects of the case thrust themselves prominently into the foreground, few are perhaps more remarkable than those malignant tumours popularly grouped under the general term of cancer. These growths are very numerous in character, they appear in widely different regions of the body, and they produce more or less profound disturbances in the organism in which they occur. They are not restricted to mankind, but, as means of investigation are improved, they are shown to afflict members of very different groups of animals included in the Vertebrata, and it may be expected that they will probably be identified in invertebrate animals also when a systematic search is made for them.

But however diverse these growths may be, both as regards the animals in which they occur and in the gross structure which they exhibit, they nevertheless present one important feature in common. They all essentially consist of cells that are multiplying in a manner uncoordinated with the requirements or advantages of the remaining cells and tissues of the animal affected. The growth as a whole behaves as a parasite—a foreign organism which lives at the expense of, and exercises a destructive influence on, the cells of the normal tissues it invades. The growth itself also betrays, in a greater or less degree, an organisation of its own, and its cells can commonly be readily distinguished from those of the host on which it preys. This independence on the part of the malignant growth has long been recognised, and it is often coupled with a power of dispersal in the body that produces new centres of infection and consequent spread of the disease. This is especially clearly shown in the case of a carcinomatous growth in mice, which can, as Jensen has shown, be transferred to the bodies of other mice by inoculation, and his results have been abundantly confirmed by Bashford and Murray in this country.

Although the cellular symptoms are for the most part not difficult to recognise, the causes that determine the origin of the neoplasm are still to seek. It is clear, however, that they operate in producing some change in cells that previously were not distinguished from those other units of which the body is composed.

Numerous theories and hypotheses have, from time to time, been advanced to account for the phenomena, but it is only when the nature of the altered structure itself is understood that we can expect to be in a position to investigate seriously the nature of the causes that produce it, and thence to bring the latter under control.

It has been suggested that a micro-organism is concerned in the production of some toxin that is more directly responsible for the mischief. Sporozoa, yeasts, psorosperms, and bacteria, have at different times been identified as the exciting causes, but careful examination has failed to confirm these statements; whilst in a number of cases it is certain that normal cell constituents themselves have been mistaken for the supposed parasites. A modification of the parasite theory assumes that the organisms are so small as to be beyond the range of microscopic vision, but that the virus they produce suffices to provoke that cell-proliferation which is so characteristic of the growth. Such a view does not appear to advance matters very much, for the supposed virus has not been isolated, nor have the organisms credited with its production been procured. It may well be that a stimulus of a chemical nature underlies the whole process; indeed, it is difficult to escape the conviction that it must do so. But the first useful stage in the inquiry would seem to consist in the obtaining of a definite conception as to the nature of the cellular changes themselves.

A second theory assumes, as its foundation, the existence of cells that have become displaced, or have withdrawn from active cooperation in the process of building up the organism during the early stages of embryonic life. These may be cells that should have been destined to give rise to the so-called "germinal epithelium," or to ordinary somatic tissues. In any event, they retain the characters and properties of embryonic cells, and are ready to start into new growth when appropriate conditions awaken them from their dormant state. But in such circumstances they are, of course, freed from the correlating influences that should and would have directed and controlled their multiplication. Thus they come to exhibit in a marked degree that potential independence which is, perhaps, possessed by every unit of nucleated protoplasm.

But this view of the existence of latent germs, scattered over the body fails to account for the remarkable nuclear peculiarities presently to be described, and indeed it seems to savour rather of a *petitio principii*, since it involves the assumption that the very occurrence of a malignant (or other) growth necessarily postulates the pre-existence of a latent germ at any spot at which the disease has made its appearance.

A third view of the nature of cancer, which may perhaps be appropriately designated as the "gametoid" theory, has quite recently been put forward. It is perhaps easily confused with the "embryonic" theory just outlined, but in reality it is essentially different from it. The gametoid theory, whilst taking account of the parasitic nature of the growth, is mainly founded on the discovery of certain quite peculiar nuclear divisions that normally only occur in connection with the formation of the sexual cells, or of their immediate precursors, in the life-history of the organism.

In the first instance it was during an investigation into the cytology of anomalous growths of ferns, on which the present writer, in conjunction with Mr. Moore and Miss L. Digby, was engaged, that certain peculiarities, previously noted, by the two observers first mentioned, on nuclear divisions in epitheliomata assumed an unexpected significance. A renewed investigation of the cytological processes obtaining in malignant growths seemed desirable, and this work was much facilitated by the additional cooperation of Mr. C. E. Walker.

As the nuclear transformations are somewhat complicated it may be well to explain more fully the relevant facts, such as may be demonstrated in any ordinary animal or plant, and then to indicate the bearing of these on nuclear divisions characteristic of malignant growths.

When an ordinary cell of the animal or plant is about to undergo division, certain definite and constantly

recurring changes become visible in the nucleus. Delicate strands make their appearance, and these finally segment into a number of rod-like or V-shaped bodies termed chromosomes. The number of chromosomes thus appearing in any nucleus of the ordinary body or somatic cells is quite constant for any species of animal or plant, though different species possess different numbers of these chromosomes. In man, for example, there are thirty-two, whilst in a lily there are

FIG. 1.—Normal Somatic Mitosis.

FIG. 2.—Heterotypical Mitosis.

twenty-four in all the body- or somatic-cells. The chromosomes become arranged in a very definite manner on a spindle-like structure, and then each of them divides longitudinally into two halves (Fig. 1). The two halves then separate, each travelling to opposite poles, and furnish the material out of which the chromosomes of the two daughter nuclei are constituted.

Although the process, as thus given in the barest outline, is constantly met with in all the somatic cells and may be traced back to the earliest divisions in the fertilised egg from which the individual has sprung, a stage sooner or later is reached in the life-history when certain cells become more or less sharply delimited from their fellows, and they finally undergo a nuclear division which is very different in character from that met with in the other cells of the body. To this particular mitosis the term Heterotype has been applied, and its onset marks a radical change that affects the organisation of the descendants of every cell that has passed through it.

The features by which the heterotype can be distinguished from all other mitoses are as follows:—The nuclei grow to a relatively larger size, and the strands from which the chromosomes arise exhibit a very characteristic "bunched" appearance at a particular stage in the process. Furthermore, the chromosomes only appear in half the numbers characteristic of the somatic nuclei. In man, for example, where the somatic number of chromosomes is thirty-two, only sixteen appear in the heterotype division. This reduction is due to the cohesion in pairs of the normal chromosomes and not to any elimination of them from the nucleus. The heterotype chromosomes further differ from the somatic ones in form, and this difference is equally marked in both animals and plants. They present the form of rings, loops, &c. (Fig. 2), instead of the familiar V-shaped figures; and, furthermore, when arrayed on the spindle each divides, not longitudinally but transversely.

Whilst this is not the place to discuss the significance of the remarkable peculiarities that distinguish this heterotype mitosis, it is essential to realise that it marks the point at which the somatic and reproductive elements diverge from each other in their future structure and development. At each succeeding division all the descendants of a cell that has once divided heterotypically retain the reduced number of chromosomes, but in other respects the normal somatic mitoses are closely simulated (Fig. 3). These post-heterotype mitoses are all distinguished as homotype.

Thus the appearance of the heterotype mitosis marks the definite segregation of a sexual series of cell generations. These may be few as in animals, where, after a single homotype division, the sexual elements are at once differentiated. In plants, on the other hand, it commonly happens that all the descendants of the heterotype generation do not actually become differentiated into sexual cells, and in any case the latter are only formed after the occurrence of a number of intervening post-heterotype divisions. These, however, are all characterised by the reduced number of chromosomes (homotype), which, as in animals, is similarly retained in the nuclei of the sexual cells. It is only on the union of ovum and sperm in fertilisation that the full somatic number is restored.

It is perhaps unnecessary to insist that the heterotype mitosis and its consequences are restricted to the reproductive tissue, at least, in the normal body; the somatic cells of the latter, in so far as they continue to divide, present the same features as before.

The general bearing of the foregoing description will become evident when it is stated that both the heterotype and homotype mitoses have been, during the recent investigations, recognised as occurring in certain cells of malignant growths.

If the advancing edge of an actively enlarging tumour, such as an epithelioma, be examined, many cells will be found to be in various stages of division. Near the margin the nuclei commonly exhibit mitoses typical of somatic cells (Fig. 1), whilst others will be encountered that show irregularities of various kinds. An excessive number of chromosomes is not uncommon (Fig. 4), and here and there pluripolar figures (Fig. 5) of a remarkable character may be observed. The latter occur somewhat unevenly distributed and owe their

FIG. 3.—Homotypical Mitosis.

FIG. 4.—Somatic Mitosis, Polar View.

FIG. 5. Pluripolar Mitosis.

origin, at least in part, to the simultaneous division of a group of adjacent nuclei on a common spindle apparatus. Yet other cells will be met with in which the process of nuclear division is of a type less complex than the normal, and it may be so reduced as to consist in the mere drawing apart of the original nucleus into two similar or even unequal halves, with a more or less complete absence of all differentiation of chromosomes.

But in spite of these irregularities that tend to obscure the more important facts, the heterotype division can be recognised with certainty in every malignant growth so far examined; and it is precisely similar in character to the normal heterotype that occurs in the sexually reproductive cell series. The same peculiarities in the early differentiation of the chromosomes culminating in the production of rings, loops, &c., the same reduction in the number, and the same transverse division of each one when attached to the spindle, reappears in these cells with the greatest uniformity.

This peculiar mitosis seems to be confined in tumours to those of a malignant character, for it has not been observed up to the present in any benign growth. It would thus appear to serve as a means of distinguishing between the two classes of growths.

Following upon the heterotype division, the homotype stage is reached, but it very soon becomes unrecognisable in most cases owing to the occurrence of the irregularities above mentioned.

The conclusion to be drawn from the above account is that, in a most important respect, some of the cells of a malignant growth have gone through a change similar to that which in normal tissues is confined to the production of the generations ending with the formation of the sexual cells. Such a conclusion is further supported by considerations derived from other sources.

It has already been pointed out that whereas in animals the differentiation of the sexual elements follows closely after the occurrence of the heterotype mitosis, this is not the case in most plants. Thus in a fern, the whole prothallium is composed of post-heterotype cells, and the sexual elements only arise from a relatively small number of them. Similarly in the embryosac of a flowering plant, there are certain post-heterotype cells that are not normally destined to give rise to sexual structures. But it is a matter of considerable interest to find that cells that fail in this respect not seldom exhibit marked irregularities in their modes of further division. Sometimes direct fission of the nuclei may occur with suppression of chromosome differentiation; in other cases the chromosomes may appear, but in quite irregular numbers.

The similarity of these irregularities to those already indicated as present in cancerous growths will at once be obvious from what has already been said.

The investigations of Bashford and Murray have served to confirm the statements previously made as to the occurrence of heterotype and homotype mitoses in the human subject. These investigators have identified the same divisions in malignant growths that occur in other mammals, in reptiles, and in fish. Whether, therefore, the explanation advanced to explain them, which involves the admission of an essential similarity as existing between the malignant growths and sexual reproductive tissue, be accepted or not, it is a fact that will have to be reckoned with.

It has been held by some persons that a transformation of somatic into reproductive tissues cannot occur, and it is, therefore, necessary to examine briefly the grounds on which such an opinion rests.

In plants the difficulty does not really arise, for a large number of cases are known in which cells that have long discharged somatic functions may revert to an embryonic condition, and then, after a heterotype division, produce from amongst their descendants the sexual elements that take part in fertilisation. This fact robs the objection of any *a priori* force it might have had. It is, however, true that amongst animals the conversion does not normally occur, but the existence of the diagnostic mitosis described above as appearing in the malignant growths affords cogent evidence for regarding them as representing such a changed condition, the true nature of which is, however, masked by the invariably pathological features that accompany it.

It is not urged that the cancer cells are functionally active sexual elements, but rather that they are homologous with such; it has, therefore, been proposed to express this idea by applying the term "gametoid" to them.

But whilst the existence of the heterotype mitosis emphasises the gametoid nature of the cells that have just passed through it, there are other phenomena that suggest the interpretation may possibly be carried on to another and further stage. Just as the true gametes (sexual cells) may fuse, so, too, cases of nuclear fusion are not very uncommon in the post-heterotype cells of malignant growths. It would be premature at the present juncture to attempt to do more than indicate that there may be something beyond a mere abnormality latent in these fusions. It is, however, a fact that in individual cases the fusion figures strongly recall instances of normal fertilisation. Should the suggestion turn out to be well founded, and many instances apparently support it, much that is still difficult of explanation will immediately become clear The irregular nuclear divisions, for example, will be no more surprising than are those so frequently to be seen in the endosperm of an angiosperm, or even in the more abnormal results consequent on polyspermy. The independence of the neoplasm and its parasitic habit, to which attention has already been directed, would be still quite explicable, for in a general sense it may be stated that a new generation habitually preys on its forbears whenever continued association with them admits of it.

But the problems that especially invite attack are those concerned with the causes of the transformation of somatic, into reproductive, cells and tissues. These fall within the scope of the physiological chemistry of the cell. Something has already been done in this direction so far as plants are concerned; and, indeed, it would seem that the lower members of the vegetable kingdom offer a more convenient material for investigation than animals. They are comparatively easy subjects of experiment, and their simpler specialisation avoids the difficulties consequent on the presence of complicated subsidiary mechanisms. The ease with which Spirogyra, for example, can be directed into either the reproductive or the vegetative phase is a case in point, and it is only one out of many that could be cited.

J. B. FARMER.

SCIENCE AND MILITARY EDUCATION.

THE *Journal* of the Royal United Service Institution for January contains a full account of the important discussion on November 9, 1903, initiated by Lieut.-Colonel F. N. Maude, *late* R.E., on the subject of military education, and on January 18 there was published a revised scheme of subjects for the entrance examinations to the Royal Military Academy and the Royal Military College respectively. The discussion at the United Service Institution, which was of a decidedly discursive character, dealt to a large extent with a real or supposed deterioration of the public school boy of to-day, or at least of those public school boys who desire to obtain commissions in His Majesty's Army.

This part of the discussion was based very largely on statements made by army tutors, which, though there may be some truth in them, must be rather carefully scrutinised. First, because army tutors are human,

and have been suffering severely for some years past from the fact that the public schools now pass their boys directly into Woolwich and Sandhurst in greatly augmented numbers, and therefore send far less of them to the tutors than formerly. And, secondly, because, owing to the above mentioned circumstance, very few boys now go to the army tutors from the public schools, in normal circumstances, unless they are a good deal below the average of public school candidates; whilst formerly, when these candidates were much less carefully looked after in many schools than they are now, a great many boys of more than average ability passed from the schools into the hands of the tutors. The change in the quality of the boys who come into the classes of the latter, therefore, probably is not due to a deterioration of the work done in the schools even if there be such a deterioration but to an entirely different cause, viz. that which we have indicated above.

The truth of the matter, judging from what was said in the discussion and other evidence, appears to be something of this sort, that the Sandhurst and Woolwich candidates of to-day, so far as concerns those "who are at all likely to obtain a commission," are seldom "wanting in the moral qualities of an officer," are "willing to learn" and "easily interested in their work for a time," but a great many of them are "mentally incapable of concentration" for anything but short periods of time. The cause of this defect is to be sought and remedied partly in the schools, partly also in modern English home life; but we fear it will never be eradicated so long as the military profession continues to be not self-supporting. And for this reason: The supply of able and ambitious young men who desire a soldier's career and who are in a position to follow a profession which will not, in most cases, support them is somewhat small, whilst the number of such young men required for officers is large. The result is that though the competition for commissions in the engineers is a real one, that for the other branches of the army is much less severe than is generally supposed. Hence the spur to work is much less than the interests of the army demand.

Other very important topics which came up in the discussion were the methods of teaching mathematics and the great need for more science in the education of officers. On both these points Colonel Maude is thoroughly sound. He advocates a far wider use of graphic methods in mathematics, and realises that the subject could and should be made more interesting, though apparently he is unaware of the recent great changes that have been effected in this department, for he remarks that he is told the method is in use in France, and that he learns from the *Engineer* that Prof. Perry recommends it in England.

On the second subject he says, "Primarily, we need" in our officers "the power to observe facts accurately, *i.e.* scientific teaching"; and again, in the discussion on his paper he pointed out, what we ourselves directed attention to a few days later, that under the proposals formulated for the examinations for entrance to the army in the future it would continue to be possible for candidates to get into the army "with no knowledge of science" and, it may be added, with no scientific training to enable them to sift facts and distinguish the true from the false.

A few days after Colonel Maude's paper was read a protest on the subject of the new regulations was made in NATURE, and there were many others, some made through the Press and others directed to the Advisory Committee. These various appeals appear to have induced the committee to reconsider the matter. But, alas! we find from the announcement made on January 18 that the committee has quite failed to understand the objections to its scheme, and that in its main feature, though not in all its details, the revised scheme is indistinguishable from that which preceded it.

In the first scheme, that which was published in November, 1903, the provisions were as follows:—

(1) That there should be a qualifying examination, which might take the form of a leaving certificate, for all candidates, and that this must include English, history and geography, mathematics (elementary), French or German, and either (*a*) science, or (*b*) Latin or Greek.

(2) That there should be in addition a competitive examination, and that for Woolwich this should include three compulsory subjects, viz. English, either French or German, and mathematics i., together with any two of mathematics ii., science, history, French, German, Latin, Greek; whilst for Sandhurst there were to be two compulsory subjects, English and French or German, together with any two of mathematics i., mathematics ii., science, history, French, German, Greek, Latin.

On the publication of this scheme it was quickly pointed out in our columns and elsewhere that it would go near to killing science in many, and perhaps in most, public schools, since, for reasons which need not be repeated, Latin would hold an advantage too great to be withstood in such a competition. On January 18 some alterations in the scheme were announced. These are as follows:—

(1) The subjects covered by the qualifying certificate will be divided, as shown below, into two classes.

Class i.—(1) English, (2) English history and geography, (3) mathematics (elementary). N.B.—All candidates must take up and qualify in each of the above three subjects.

Class ii.—(1) Science, (2) French or German, (3) Latin or Greek. N.B. All candidates must take up and qualify in any two of the above three subjects (1), (2) and (3).

(2) No candidate will be allowed to take out a leaving certificate or its equivalent, or pass the qualifying literary examination, before he has attained the age of seventeen years.

(3) The languages which may be taken up as voluntary subjects at the competitive examination for admission to the Royal Military Academy or Royal Military College will be—German or French, and Latin or Greek.

No doubt at first sight this seems a considerable change in the right direction, since it appears to put science on an equal footing with French or German and with Latin or Greek. But if we look more closely into the proposal we see that one of these three subjects, viz. French or German, and one only, is compulsory for both Woolwich and Sandhurst in the competitive part, and must, therefore, be taken up at the qualifying stage also by practically every candidate. Thus the scheme in its new form is only the original scheme rewritten. The real alternative is still, as before, between science and Latin or Greek,[1] and between these two only.

It is nothing less than astounding that the body of officers and gentlemen who have now had this matter before them for several months should so little understand the certain effect of their own regulations that they could put forward this change, which is no change, after all that has been said and written on the subject.

Taken as a whole, the new proposals do, it is true, make a slight alteration. In part ii. candidates will be unable to take up two modern or two classical languages, which may tend in some slight degree to widen the school training of a few of the candidates.

[1] Really, in effect, between science and Latin.

But on the main point they wholly fail to meet the objections that have been brought forward.

In our opinion it is a great misfortune in view of the present state of affairs that the War Office has only so lately become aware of the existence of the University of London, and that consequently Sir Henry Roscoe, who has given much attention to the subject of army examinations for many years past, has only joined in the consultations of the Advisory Committee since the committee concluded the consideration of this subject. For this circumstance has prevented the committee from having the benefit of his opinion upon the doubly vital question—vital equally for the army and for English public school education in the immediate future—What is the proper position for experimental science in the education of an officer?

MINERAL OUTPUT OF INDIA.

THE progress of India as a mineral-producing country is made plain by the following diagrams, which have been compiled from a statistical abstract recently issued by the Indian Government.[1]

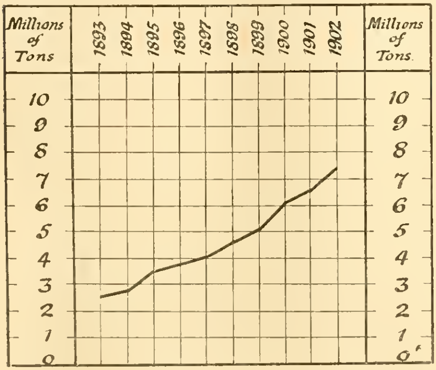


FIG. 1.—Output of Coal.

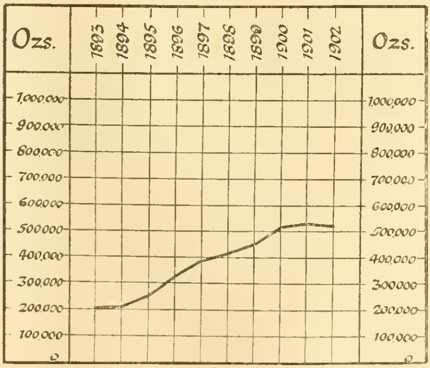


FIG. 2.—Output of Gold.

The output of coal has risen from $2\frac{1}{2}$ million tons in 1893 to nearly $7\frac{1}{2}$ millions in 1902; 84 per cent. of the coal is raised in Bengal. The yield of gold, which

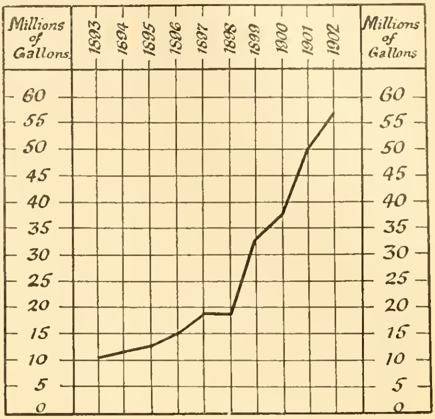


FIG. 3.—Output of Petroleum.

comes mainly from Mysore, is $2\frac{1}{2}$ times what it was ten years ago. The quantity of petroleum produced has increased more than five-fold, and the rise in the

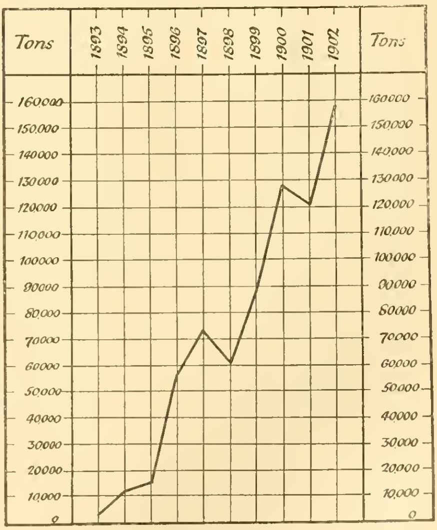


FIG. 4.—Output of Manganese Ore.

output of manganese ore is still more striking. The petroleum is supplied principally by Burma, whilst the manganese ore comes partly from the Central Provinces and partly from Madras.

1 "Statistics of the Mineral Production in India in the Ten Years 1893 to 1902." (Calcutta, 1903.)

ACCOMMODATION OF SCOTTISH SCIENTIFIC SOCIETIES.

THE movement for the accommodation of the Scottish scientific societies in the Royal Institution Building, Princes Street, Edinburgh, to which we referred in the issue of December 3, 1903, has advanced a stage. On Tuesday, January 19, Mr. Graham Murray, M.P., the Secretary for Scotland, received a representative deputation consisting of the council of the Royal Society of Edinburgh, and delegates specially appointed by the other societies interested. The deputation was introduced by Sir John Batty Tuke, M.P. Lord Kelvin, Sir John Murray, Sir William Turner, Sir E. Rowand Anderson, Lord Playfair, Mr. Bernard, Lord McLaren, and the Lord Justice Clerk made brief statements on behalf of the more important societies represented, each speaker devoting attention to some particular aspect of the scheme. The concentration of scientific effort, the practical unification of important libraries, which under present conditions could not be utilised to anything like their full extent, the enlarged scope the scheme would give for the encouragement of scientific research, the educative value of such a scientific centre upon the community at large, were all touched upon. It was also pointed out that the movement had its origin in the recent report of the departmental committee on the constitution and functions of the Board of Manufactures, and could not, of course, be realised until the schools of art at present accommodated in the Royal Institution were otherwise provided for. The Secretary for Scotland in his reply expressed his sympathy with the object aimed at, although it was impossible for him to commit himself at present to the furtherance of any scheme which might naturally follow the acceptance of the departmental committee's report. It must be remembered that there were other interests to be considered, and that it was impossible adequately to provide for all claims without removing from the Royal Institution some of the parties already in possession. It might be possible at a less cost and more efficiency to find accommodation for societies like the Royal Society in another building with a less expensive site. At the same time he felt that this was the fitting time for bringing forward a scheme of the kind advocated, when the whole question must be faced and the present chaotic condition of affairs done away with. Referring to some of the practical details which would have to be taken up in carrying out the scheme, the Secretary for Scotland asked if the societies interested had considered the question of the up-keep of the building, and Sir William Turner replied that that question had been gone into very fully, and that they were prepared to accept much the same conditions as held in regard to Burlington House and the various societies housed there, that is, that they were prepared to act the part of tenants if the Government would do the outside or landlord's repairs. Mr. Graham Murray concluded by saying that he would do his best to impress upon the Government the necessity of dealing adequately and generously with what had long been a clamant want.

C. G. K.

DR. GEORGE SALMON, F.R.S.

GEORGE SALMON was born in Dublin on September 25, 1819, and having received his school education in Cork, he entered Trinity College, Dublin, and graduated in the year 1838 after a distinguished university career. He was elected to a scholarship in classics in 1837, and obtained first senior moderatorship at the honour degree examination in mathematics in 1838. In 1840 he was awarded the Madden's premium, having, in the opinion of the examiners at the fellowship examination, "best deserved to succeed if another fellowship had been vacant." In the year following he was elected to a fellowship. In due course he became tutor, his duties being to lecture to classes of ordinary students twice a day during term, to assist in examining and to advise and direct his pupils. With a large chamber of pupils, such as Salmon's, this work, though not severe, is liable by its frequent interruption to render it extremely difficult for a tutor to carry out any systematic original work; but Salmon knew the value of time, and with his wonderful power of abstraction he produced most of his forty-one mathematical papers and his four great mathematical treatises during his twenty-five years' service as tutor. In 1858 he was appointed Donegal lecturer, and taught engineering students the calculus in addition to his tutorial work. In 1859 he proceeded to the degrees of B.D. and D.D., and he published in 1861 his first series of sermons preached in the Chapel of Trinity College.

It was natural that a man of Salmon's originality and versatility should have desired freedom from the irksome duties of a tutorship, and in 1862 he was regarded as the fitting successor to Graves in the chair of mathematics. Preferring, however, the Archbishop King's lectureship in divinity, which fell vacant about the same time, and believing he was certain to be elected to this lectureship, he did not present himself as a candidate for the professorship. An unfortunate mistake and the claims of seniority disappointed him, and it was not until 1866 that election to the regius professorship of divinity relieved him from his long tutorial labours. He was obliged to resign his fellowship, and with it his right to cooption by the board, which would have occurred in 1876.

This is not the place to speak of his work as professor of divinity, of his treatises on theological subjects, of the splendid services he rendered the Church of Ireland during the years following the disestablishment in the revision of the Prayer-book and in matters of finance. Suffice it to say that Salmon's powers seemed to increase with his years, that his capacity for hard work remained intact almost to the end of his life, until, in his latest written words, "my chariot wheels are now running so heavily that you need not be surprised to hear at any time that they have ceased to move at all."[1]

In 1888, on the death of Jellett, Salmon was admitted provost of Trinity College by Letters Patent. He was then in his sixty-ninth year, and he held the office longer than any provost since the Right Hon. Hely Hutchinson, who died in 1794. It was no light task to which he was called. The governing body of the University of Dublin consists of the provost and the seven senior fellows. The provost is appointed by the Crown. The senior fellows attain their position by virtue of seniority, the sole condition having been their election to a junior fellowship on the results of an examination. This board transacts practically all the business of the university. Its members hold the offices of vice-provost, registrar, bursar, senior lecturer, senior dean, catechist, auditor and senior proctor. In addition it not unfrequently happens that a member of the board is librarian, or that he takes part in the examination for fellowship or in some other important examination. There is nothing to correspond to the Cambridge syndicates unless it be the medical school committee or the academic council, and of the former a member of the board is the chairman, while at least three senior fellows and the provost have belonged to the latter since its inception in 1874, the provost being the *ex officio* chairman.

[1] From letter to the Bishop of Chester dated January 12.

Indeed, Dr. Salmon had no small share in the origination of the academic council—"to cooperate (with the Board) and have a share in the regulation of the Studies, Lectures, and Examinations . . . and in the appointment and election of Professors," but during his masterful tenure of the provostship the power of the council was not of importance. Enough has been said to show the difficulty of Dr. Salmon's office as the head of a responsible board overloaded with duties of the most multifarious kind—a board composed of eight men whose united ages at one time approached if they did not exceed the magnificent total of five hundred and eighty years.

However, Salmon was not an old man at seventy, nor, indeed, at eighty, nor did he appear so at eighty-four to anyone who had the good fortune to enjoy at his most hospitable table the delightful flow of his quaint and simple humour. No doubt he did in his later years grow weary of prolonged controversy, and he was willing to put things off with "It will do very well for my time," or he would use his inimitable powers of ridicule or employ the most fantastic and ingenious arguments to crush any proposal that had not his approval. It might have been otherwise had his duties been less laborious, had he not felt constrained to rule the board with a rod of iron, had he, in fact, more time to consider matters which did not claim his immediate attention, yet perhaps he did not fully realise the enormous changes that had taken place in Trinity College during his connection with it—changes due to the growth of knowledge and to the varied conditions of the tenure of fellowship. Since Dr. Salmon obtained fellowship the number of professorships and lectureships has been just doubled. When he entered the college the celibacy statute was in force, and with few exceptions fellows were obliged to take orders. Rich livings and church preferment were to be had. It was possible even for a professor of astronomy to step into a bishopric. Many of the professorships then held by fellows or by ex-fellows are held by fellows no longer. A new and most important body of men has come into existence—the non-fellow professors men hardly thought of in the days when all power and all authority was vested in the provost and the seven senior fellows. The senior fellows are not what they were just before Salmon's time. The allurements of matrimony or the seductions of great ecclesiastical positions used to produce a rapid flux, and a senior fellow was generally coopted in the prime of life—not as now the survivor of a set of men whose constitutions have been most thoroughly tested by the rigours of an appalling examination.

Though Salmon was one of the first to experience these changes, they did not appear to him to warrant any corresponding adjustment in college affairs, and some deplore his inaction, yet Trinity College must be ever grateful to her late provost for the noble conservatism with which he defended her independence. He claimed to be the *Ordinary* of the college chapel, and would not admit the jurisdiction of the Archbishop of Dublin. He took a leading part in the provisions relating to the position of the divinity school, which is absolutely free from clerical domination, its professors being elected by the board on their merits and on their merits alone. Moreover, it must be remembered that the board is now being recruited from fellows only three of whom have taken orders out of the thirty-five elected since the obligation to take orders was repealed; that there is absolutely no religious test for fellowship candidates, so that it is theoretically possible that a board exclusively composed of Mohammedans may at some time be called upon to elect the professors in divinity. He was willing to afford Roman Catholics every facility for religious exercises within the walls of Trinity College, but he would suffer no clerical interference, whether from the Church of Ireland or the Church of Rome. Indeed, those who know anything of Trinity College can detect little of the "Protestant atmosphere" which its opponents say is so oppressive there, though there may be an "anti-clerical atmosphere," if we take the phrase to mean that clerical interference will not be tolerated in the teaching of divinity, science or letters.

Those who had the privilege of knowing Salmon will think of him as a man not as the great mathematician, the great theologian or the great head of affairs. As a man he was superb—the kindest of friends, the keenest and most subtle of opponents, the most charming and delightful of companions, the best of men. His figure was well known in Dublin—nearly every afternoon he might be seen wandering through the streets; he was a great lover of music, a great chess-player, an omnivorous reader of novels. For many years he was greatly attracted by the theory of numbers[1]—he said it almost amounted to a disease with him, and he was often seen avoiding the tedium of some meeting by scribbling on his scraps of paper in his search for primes and for periods of recurring decimals. Yet he took the widest interest in ordinary matters. Many Dubliners will recollect their astonishment at seeing the venerable provost less than a year ago leaving Kingstown on an exceedingly rough day in a small boat to visit the Channel Fleet, which lay at some considerable distance outside the harbour. Many a time he has surprised his friends by writing to them from some remote Swiss valley inaccessible to many a far younger man.

Salmon's first paper was published in 1844, "On the Properties of Surfaces of the Second Degree which Correspond to the Theorems of Pascal and Brianchon on Conic Sections" (*Phil. Mag.*, xxiv.); his last mathematical paper was "On Periods in the Reciprocals of Primes" (*Messenger of Mathematics*, 1873, pp. 49–51). The majority of his papers have reference to numerical characteristics relating to curves and surfaces, and many of these results are summarised in the great chapter "on the order of restricted systems of equations" in his "Modern Higher Algebra." It would be most unfair to Salmon to judge of his contributions to mathematics by his papers alone. He had a great dislike to the physical trouble of writing; he modestly communicated his discoveries to friends or reserved them for incorporation in his books, so that it is a matter of extreme difficulty to say how much is his. Apart from his discovery of new facts, the methods employed in his books must have been of tremendous service in promoting the advance of mathematics. His style was characterised by a complete absence of pedantry and by profound common sense. By a few words, by some geometrical illustration, he dispensed with pages of troublesome analysis. At times the great condensation of his diction may conceal from the casual student the width and the depth of his conclusions, but on referring to an original memoir from which he quotes one is amazed to find that every essential point is reproduced, and that frequently some brilliant addition has been made and left unclaimed by him. It must not be supposed that Salmon shared the characteristic attributed to MacCullagh of shirking analysis and trusting to his great geometrical insight. On the contrary, he seemed to revel in analysis so tedious and so intricate that it would be distasteful to most mathematicians. He says,[2] "By means of the differential equation I calcu-

[1] Having nearly completed a book on this subject, he burned it for some unknown reason.
[2] "Treatise on Modern Higher Algebra," art. 260.

lated the invariant E. Its value was given at length in the second edition, where it occupied thirteen pages, but I have not thought it worth while to reprint so long a formula." Yet to the volume which contained this elaborate investigation and many others involving equal skill and almost equal labour he prefixed the words:—"To A. Cayley, Esq., and J. J. Sylvester, Esq., I beg to inscribe this attempt to render some of their discoveries better known, in acknowledgment of the obligations I am under, not only to their published writings but also to their instructive correspondence."

Questions of priority must be left to some more learned pen, and to a writer who has less reason to revere Salmon and to respect his reticence. The value of his work is shown by the number of the editions and of the translations of his treatises, and by the honours he received from every quarter. To a friend who might question him about his honours he would say, "You will find all about them in that drawer." He received them with humility, though he well knew he was worthy of them.

DR. W. FRANCIS.

Dr. William Francis, whose death we recorded last week, was born in London in February, 1817. After his school-time, spent partly at University College School, but chiefly in France and Germany, at St. Omer, Cravelt, and Gera, he studied for a short time at University College, London (then known as the University of London), whence he proceeded to the University of Berlin and subsequently to Giessen, where Liebig was then at the height of his scientific activity. Here he took the degree of Doctor of Philosophy in 1842. His long residence abroad, supplemented by frequent subsequent journeys, many of them on foot, gave him an accurate knowledge of French and German, and enabled him to become personally acquainted with a very large number of the leading men of science on the Continent.

In 1842 he established the *Chemical Gazette*, which he continued to edit until December, 1859, when it was merged in the *Chemical News*. By this publication and by the translations and abstracts he contributed for many years to the *Philosophical Magazine*, he did valuable service in making known the work of foreign chemists to their English colleagues. Among other work of the same kind were translations of important foreign papers, including Ohm's "Die galvanische Kette mathematisch bearbeitet" and Helmholtz's celebrated paper, "Die Erhaltung der Kraft," for Taylor's "Scientific Memoirs." From 1851 until his death he was one of the editors of the *Philosophical Magazine* and of the *Annals and Magazine of Natural History* from 1859. His wide acquaintance with various branches of science, as well as with leading scientific men at home and abroad, made him well fitted for these functions, and the sound judgment with which he discharged them is generally recognised.

Dr. Francis was one of the original members, probably the last survivor of them, of the Chemical Society, having been elected an Associate in 1841 and a Fellow shortly afterwards. He was elected a Fellow of the Linnean Society in 1844. He was also a Fellow of the Royal Astronomical Society and an original member of the Physical Society. For the greater part of his life Dr. Francis was actively engaged in business as a partner, since 1852, in the well-known firm of Taylor and Francis, successors of Richard and John E. Taylor, printers and publishers.

He died at his residence, the Manor House, Richmond, on January 18.

NOTES.

A provisional committee has been formed with the object of commemorating the scientific work of the late Prof. A. Cornu by means of a medal struck for that purpose. The committee includes more than fifty members of the Institute of France; and the secretary is M. E. A. Martel, 8 Rue Ménars, Paris.

The King, accompanied by the Queen, opened Parliament in state on Tuesday. In the King's speech reference was made to the insufficiency of the supply of the raw material upon which the cotton industry of this country depends, and the hope was expressed that the efforts which are being made to increase the area under cultivation in various parts of the Empire will be attended with success. Among the measures to be introduced is a Bill to amend the laws relating to education in Scotland.

A Laffan message from Rome states that the Academy of Sciences at Turin has divided the Ballauri prize of 1200*l*. between Signor Marconi and Prof. Grassi, of Rome, and has awarded the Brasso prize of 350*l*. to the Duke of the Abruzzi.

Dr. D. H. Scott, F.R.S., has been elected president of the Royal Microscopical Society for the ensuing year.

The *Daily Chronicle* announces the death of Mr. W. G. McMillan, secretary to the Institution of Electrical Engineers.

The petition of the Linnean Society of London praying for the grant of a supplemental charter has been referred to a committee of the Lords of the Privy Council, and is down for consideration by their lordships on March 1.

A petition in support of the Bill for the adoption of the metric weights and measures, which will be introduced in the House of Lords by Lord Belhaven and seconded by Lord Kelvin, is being extensively signed throughout the kingdom.

Prof. Henri Cordier, of the School of Modern Oriental Languages at Paris, has been appointed president for 1904 of the Geographical Society of Paris.

The thirty-first annual dinner of the old students of the Royal School of Mines will be held on Friday, February 26, at the Hotel Cecil. The chair will be taken by Mr. A. G. Salamon. Tickets may be obtained from Mr. David A. Louis, 77 Shirland Gardens, London, W.

At the annual meeting of the Psychical Research Society held on January 29, it was announced that the fund intended to endow a research scholarship had reached 6195*l*., but a minimum of 8000*l*. is needed. Sir Oliver Lodge, the retiring president, introduced the new president, Prof. W. F. Barrett, who delivered his presidential address.

It is proposed to hold a horticultural and gardening exhibition in the month of June next under the auspices of the Royal Botanic Society in the new exhibition grounds of the society, situated in the centre of the Botanic Gardens in Regent's Park. The proposed scheme embraces horticulture, forestry, botany, educational methods, nature-study, and a special section for colonial produce. In addition to the exhibition, lectures and conferences are in course of arrangement.

Grants in aid of research have recently been made from the Rumford fund of the American Academy of Arts and Sciences as follows:—to Prof. E. W. Morley, for his research on the nature and effects of ether drift, 100*l*.; to Prof. Carl Barus, for his research on the study by an

optical method of radio-actively produced condensation, 40*l.*; to Mr. J. A. Dunne, for his research on fluctuations in solar activity as evinced by changes in the difference between maximum and minimum temperature, 40*l.*

At the ordinary quarterly meeting of the Royal College of Physicians held on January 30, Sir William Church announced that Dr. Horace Dobell, of Parkstone Heights, Dorset, had presented a sum of 500*l.* to the college for the promotion of original research into the ultimate origin, evolution, and life-history of bacilli and other pathogenetic micro-organisms. The conditions are that the president and censors of the college shall select a lecturer once in every two years, who shall give a record of original researches on the above subject, made by others and himself, and that he shall receive a fee of 50*l.* for so doing. These lectures are to be continued biennially, as long as a sufficient amount of the 500*l.* and its accumulated interest remains. The first lecture will be delivered during this year.

The death is announced of Mr. William Vicary, of Exeter, who had an intimate acquaintance with the local geology and possessed a fine collection of fossils, chiefly from the Upper Greensand of Haldon and Blackdown. He first directed attention to the occurrence of fossils in the quartzites of the Triassic pebble-bed of Budleigh Salterton. The death is also announced of Mr. Alfred Gillett, of Street, near Glastonbury, in his ninetieth year. He gathered together a fine collection of fossils, which he presented in 1887 to the Crispin Institute at Street. One of the gems, however, an almost entire skeleton of *Ichthyosaurus tenuirostris*, obtained from the Lower Lias of Street, and personally developed by Mr. Gillett, was presented to the British Museum (Natural History).

News of the sudden death of Miss Anna Winlock, a member of the staff of the Harvard College Observatory, has reached us from Boston. Miss Winlock's first official computing work at the observatory was done in 1875. Later she passed to more advanced work, as she was conversant with most branches of mathematics as applied to astronomy, had studied various methods of star reduction, and understood the use of the theory of probabilities. She did a large part of the computation for Prof. Rogers's zone work, of which a description is given in vol. xv. of the *Annals* of the observatory. In 1886 Miss Winlock was joint author with Prof. Rogers of a paper on "The Limitations in the Use of Taylor's Theorem." In connection with the photographic work of the observatory a convenient catalogue of close polar stars was needed, and this work was carried out by Miss Winlock for both the north and south poles. The result of this work was the most complete catalogue of close polar stars ever made, and the best means of comparison of different observations. The next important piece of work done by Miss Winlock was the catalogue published in the *Annals* of the observatory of the positions of five hundred stars near the North Pole, which had been observed photographically. After the discovery of the minor planet Eros, some work of the same nature was done by Miss Winlock, in determining its precise position from photographic plates. Her death deprives astronomy of one whose faithful and exact work has a permanent value.

Messrs. Burroughs, Wellcome and Co. have issued a reprint of the historical souvenir on "Antient Cymric Medicine" prepared by Mr. Wellcome on the occasion of the meeting of the British Medical Association at Swansea, 1903. The pamphlet, which is profusely illustrated, contains much interesting information.

Last autumn a commission of the American Marine Hospital Service reported that it had discovered a protozoan parasite, the so-called *Myxococcidium stegomyiae*, in the yellow fever mosquito, *Stegomyia fasciata*, that had bitten yellow fever patients. Dr. James Carrol now states (*Journ.* Amer. Med. Assoc., November 28, 1903) that this supposed protozoon is merely a yeast fungus accidentally infecting the mosquitoes, and has nothing to do with the transmission of yellow fever.

Popular confirmation of the value of scientific methods and advice is always welcome. In a letter to the secretary of the Liverpool School of Tropical Medicine, the Booth Steamship Company gives an extract from the log of its steamship *Javary*. Her captain reports that the mosquito nets supplied by the company have been a great boon to the men, and that whereas cases of malaria were formerly frequent, sometimes resulting fatally, since the introduction of the nets and their general adoption the crews have enjoyed a wonderful immunity from sickness.

The January number of the *Journal of Anatomy and Physiology* (part ii., vol. xviii.) contains a number of papers of anthropological, anatomical, physiological, and embryological interest, and is illustrated with several plates. Mr. Wright describes a number of skulls obtained from the round barrows of east Yorkshire, Mr. Lewis discusses the functions of the spleen and other hæmolymph glands, and Prof. Elliot Smith publishes a note on an exceptional human brain presenting pithecoid abnormality. Prof. Arthur Robinson's first Hunterian lecture on the early stages in the development of mammalian ova is printed *in extenso*, and Dr. Beard gives another instalment of his article on the germ cells.

Messrs. A. E. Staley and Co., of 35 Aldermanbury, E.C., have sent us a prism binocular which magnifies eight times, and costs five guineas complete in a solid leather case. It is strongly made, weighs barely 12 ounces, and has a fairly large field of view. It differs from many other glasses of this construction in that there is no means of altering simultaneously the focus of the two sets of lenses. It is intended that each eye-piece should, in the first place, be focused carefully on an object situated at a distance of about 300 yards, the divisions on each of the eye-pieces being carefully noted. For all objects distant 100 yards or further from the user the glasses are in focus without any other manipulation, and are therefore always ready and in adjustment. If the glass be employed for nearer objects this principle is not satisfactory, for then each eye-piece would have to be focused separately, which would entail time. The general use of such binoculars is thus somewhat restricted, but for those who would employ them for such purposes as stalking, yachting, shooting, &c., and who thus do not require shorter ranges than 100 yards or so, they should be of service. The elimination of the arrangement for focusing both eye-pieces together renders it possible to make the glasses lighter, stronger, and more secure from derangement. An examination of their interior shows the simplicity of construction, and the definition leaves little to be desired.

The *Atti dei Lincei*, xii. (2), 12, contains a biographical notice of the late Prof. Luigi Cremona, by Prof. G. Veronese, together with a list of his principal writings, eighty in number.

In a supplement to the *Communications* from the Leyden Physical Laboratory, Dr. J. E. Verschaffelt discusses, with a diagram, the form of the Van der Waals Psi surface in

the neighbourhood of the critical point for binary mixtures with only a small proportion of one component.

A NOTE on the b constant of Van der Waals's law is contributed by Mr. J. D. van der Waals, jun., to the *Physikalische Zeitschrift* for January 1. By different methods Van der Waals and Boltzmann have arrived at the formulæ $b = b_\infty - 17b_\infty^2/32V$ and $b = b_\infty - 3b_\infty^2/8V$, and the writer now claims to have proved that the latter is the correct value.

A PORTRAIT of the late Father Stephen Joseph Perry, F.R.S., director of Stonyhurst Observatory, is reproduced in *Terrestrial Magnetism and Atmospheric Electricity* for September, 1903 (recently received), accompanied by a short biographical sketch. Prof. H. F. Reid contributes to the same number a short account of the second International Seismological Conference which met in response to a call from the German Government at Strassburg from July 24 to 28 of last year to discuss the formation of an International Seismological Association.

INTERNATIONAL balloon ascents, both manned and unmanned, were made on November 5 and December 3, 1903, by many European countries (the British Islands excepted), and kite observations were also made at the Blue Hill Observatory, United States. The highest altitudes attained were:—Trappes (near Paris) 16,000 and 14,800 metres, and Itteville (near Paris) 11,200 and 10,800 metres. At Zurich the balloons reached 13,000 and 17,000 metres. Kite observations were also made at Torbino, at the private observatory of M. Demtschinsky. From its northern position, latitude 58° 38′, not far from Pavlovsk, these observations are of special interest. The meteorological results will be published later on.

WE have received the report of the chief of the U.S. Weather Bureau for 1903; it contains a most interesting summary of the great work carried on by that department, furnishes ample proofs of the usefulness of its operations, and gives great hopes of ultimate improvement of our present knowledge of meteorological conditions. The operations of the U.S. Weather Bureau are naturally of much greater proportions than can be possible in our own country. It issues each morning (Sundays and holidays excepted) about 25,000 maps exhibiting graphically, with text and tables, the weather conditions at 8h. a.m.; about 50 per cent. of these maps are produced at the larger outlying stations of the bureau. The expenditure on various branches of the service amounts to one and a quarter million dollars, and the independent comments of the Press give evidence that the high average of success of the warnings of storms and of cold waves affecting agriculture and crops "brings an adequate return to the commerce and industries of the country." Prof. Willis Moore states that the Weather Bureau has for some years been carrying on an investigation into the fundamental problems as to the true causes of weather conditions, and that the construction of high-level charts based chiefly on cloud observations points unmistakably, in Prof. Bigelow's opinion, to a theory which will supersede those heretofore published in meteorological literature. With reference to the problem of seasonal forecasts, Prof. Moore states that meteorology is really a very closely allied but difficult branch of solar physics, and ought to be studied with the aid of a fully equipped observatory devoted especially to such researches. In this sense suitable reference is made *inter alia* to the Solar Physics Observatory at South Kensington, which is putting forth valuable results under the directorship of Sir Norman Lockyer.

THE third number of *Spolia Zeylanica* contains an exceedingly interesting account, by Mr. Everard im Thurn, the Lieutenant-Governor of the island, of last year's pearl-fishery in Ceylon. This fishery took place after an interval of eleven years, and the gathering of both Europeans and natives was consequently very large. The results are not yet made known. Mr. im Thurn himself donned a diver's dress and descended to the oyster-beds—a depth of about nine fathoms. To a novice such an experience entails many unpleasant sensations, but the author deemed himself well rewarded by the sight which met his eyes on the sea-bed, when all pains were forgotten in the interest of his surroundings. It is pointed out that a good many pearls lying near the mouths of the oysters are abstracted by the divers during the return from the fishing grounds to shore. The fishing was continued for a period of about two months, at the end of which the native divers were utterly exhausted. Before the next fishery, the Government hopes to find some more scientific method of reaping this harvest of the sea than the one which has been in vogue for untold centuries.

AN interesting addition has recently been made to the Natural History Museum, South Kensington, by the receipt of specimens of some of the blind cave-fishes of Cuba, which were described by Prof. Poey in his "Memorias sobre la Historia Natural de la Isla de Cuba" so long ago as 1856, but which, up to this time, have remained unrepresented in European museums. The special interest of these fishes (*Lucifuga subterraneus* and *Stygicola dentatus*) lies in the fact that their alliance is with salt-water forms (such as Brotula) which exist in the neighbouring sea, and not with fresh-water fishes, as is the case with Amblyopsis and its allies of the Great Cave of Kentucky. There can be little doubt that the Cuban caves in which the blind fishes are found were formerly in communication with the sea, and that the ancestors of these fishes entered the caves from the adjacent ocean. It is, however, a matter of speculation how long a period of life in darkness it has taken to reduce the eyes of these fishes to their present rudimentary state and to effect the other changes which now distinguish them from their nearest marine relatives.

A SHORT biography of the late Major J. W. Powell, of Washington, has recently been compiled by Mr. G. K. Gilbert from a series of articles by various writers in the *Open Court*. From his early youth he lived a strenuous life, both physical and mental, his varied reading being rectified by much field work. He lost his right arm in the Civil War, in which he served as an engineer. Then he was offered the chair of geology in the Illinois Wesleyan University, and there organised field expeditions as part of the official curriculum in the geological and natural history studies. He resigned his professorship to undertake the exploration of the canyons of the Colorado River, and was the first to descend that dangerous river. Major Powell was appointed director of the U.S. Bureau of Ethnology in 1879, and also director of the U.S. Geological Survey in 1881; the latter office he resigned in 1894, but he kept the former until his death in September, 1902. Not only was Major Powell a hard worker, but he was a stimulating chief and was very fertile in ideas, which he freely gave to others. The loving reverence that was paid to the "Major" by his colleagues comes out strongly in the report (*Science*, November 14, 1902, p. 783) of the meeting that was held before his funeral.

WE have received from the author, Mr. H. H. Bloomer, a paper from the *Journal of Malacology* (vol. x. part iv.) on the anatomy of the molluscs *Pharella orientalis* and *Tagelus rufus*.

The fourth part of vol. lxxv. of the *Zeitschrift fur wissenschaftliche Zoologie* is taken up by two papers on parasitic organisms. In the first, Dr. R. Ritter von Stummer-Traunfels commences a general account of the anatomy and histology of the Myzostomaria, those remarkable annelids parasitic on crinoids and starfishes, with a description of *Myzostoma asteriae*. In the second Mr. F. Schmidt describes *Branchiobdella parasita*, an oligochaete worm infesting the gills of the crayfish.

The first appendix tu the Kew *Bulletin* for the present year has been received. It contains a list of. seeds of hardy herbaceous plants and of hardy trees and shrubs which ripened at Kew during the preceding year. The unfavourable conditions which prevailed have considerably reduced the number of species in the list.

The *Journal of Botany* (January) opens with the first part of an account of R. Brown's list of Madeira plants, which is contributed by Mr. J. Britten. The Rev. W. M. Rogers presents a general list of plants gathered in the three botanical counties which form the subprovince of the north-east Highlands, and gives separately the collections made near Tomatin and Dalwhinnie, two stations situated above the thousand feet level.

Signor F. Ardissone has made a study of the flora of Monte Baro, a peak near Lake Como, and publishes a list of the plants collected there in the *Memoirs* of the Lombardy Institute of Science and Arts. Despite the somewhat low altitude and the circumscribed area of the mountain, the number of species is considerable, and the flora contains several types which are sparsely distributed in Lombardy, this being especially noticeable in the case of the orchids.

An account of the native timber trees is contributed by Mr. A. O. Green to the *Proceedings* of the Royal Society of Tasmania. The author not only describes their specific qualities and uses, but is able to give the results of tests which he has made in order to determine the strength of the more important of these. Owing to the scarcity of soft wood trees in Australasia, it is interesting to note that two valuable pines, the huon pine, *Dacrydium Franklinii*, and the celery-top pine, *Phyllocladus rhomboidalis*, are both said to be common, the former being, however, only locally abundant.

A small brochure upon the application of electricity to the cultivation of plants has been received. The writer, M. Guarini, has summarised the principal experiments which have been recorded under two heads, distinguishing between those in which electricity has been adopted as the source of continuous artificial light and those in which the plant is stimulated by electric currents. The latter method is the more important, and, according to the experiments of M. Lemstroem and others, the results are distinctly beneficial, mainly in the increased amount of growth.

The *Mitteilungen aus den deutschen Schutzgebieten* contains a new map of the central part of Kamerun, between Sanaga and the eighth parallel of north latitude, by Herr M. Moisel. The scale is 1 : 1,000,000, and the map includes much new and unpublished material.

The first number of the new volume of the *Abhandlungen* of the Vienna Geographical Society is devoted to the introductory part of a valuable monograph on the Federated Malay States, by Mr. W. R. Rowland. The section issued deals with the physical geography of the region and its flora and fauna. Publication has unfortunately been delayed for two years, but the paper has been brought up to date by competent hands in Vienna. The second part, which will apparently deal with the development of the States under British protection, is to be accompanied by a map.

The *National Geographic Magazine* for January contains, besides a number of short articles of interest, a report of an address delivered before the National Geographic Society by Mr. F. H. Newell, chief engineer of the Reclamation Service, United States Geological Survey. The Reclamation Service is responsible for the carrying out of a law passed by Congress in 1902, which provides that the proceeds of the disposal of certain public lands shall be set aside for the construction of irrigation works in the arid regions of the west. Mr. Newell gives some account of the progress of work up to the present time. The paper is illustrated by a number of useful physical maps.

A third edition, which has been greatly enlarged and almost entirely rewritten, of Dr. A. Rabagliati's "Air, Food and Exercises. An Essay on the Predisposing Cause of Disease," has been published by Messrs. Baillière, Tindall and Cox.

Messrs. Charles Griffin and Co., Ltd., have published a third English edition of "The Cyanide Process of Gold Extraction," by Prof. James Park, the first edition of which was reviewed in Nature for June 14, 1900. The text-book has been revised and enlarged, much new material—dealing for the most part with lead-smelting of gold-slimes, the sulpho-telluride ores, and filter-press practice—having been added.

Women workers in all branches of activity will find something useful to them in the "Englishwomen's Year Book and Directory, 1904." Miss Emily Janes, who edits the volume, is to be congratulated upon the completeness of the new issue of this annual publication. The volume contains sections dealing separately with science and education. The former includes brief notices of the research work in science upon which women are at present engaged; a list of the principal scholarships and exhibitions for science attainable by women; and lists of the societies of which women may become members, and of women who are engaged as examiners or lecturers in science. The section of the "Year Book" dealing with education contains an excellent account of the present facilities for the higher education of women in our home universities.

A new magazine for technical students, entitled *Technics*, has been started by Messrs. Newnes, Ltd. The new periodical is designed to become the organ of the great body of students of technological science throughout the country. If the magazine, as its founders intend it to do, succeeds in increasing the number of people interested in technical and scientific work, and in becoming a medium for the interchange of ideas between those engaged in technical instruction, it will have fully justified its existence. The contents page of the first number is an exceedingly varied one, ranging as it does from the art of dyeing to the training of chauffeurs. Among the articles may be mentioned a description of the Technical High School at Charlottenburg, by Prof. Dalby; on radium, by Mr. E. Edser; on rapid-cutting steel, by Prof. J. T. Nicolson; and contributions on different aspects of the technical education problem by Sir William Abney, Sir William White and others.

A second edition of vol. ii. of Dr. F. Dannemann's "Grundriss einer Geschichte der Naturwissenschaften" has been published by Mr. W. Engelmann, Leipzig (London: Williams and Norgate). The volume deals with the de-

velopment of scientific knowledge from the time of Thales to the present epoch; and though it is impossible to compress the history of science into 450 pages, the author's survey of progress is excellently conceived and carried out. Original texts and illustrations are given prominence, so that the student who reads the work cannot fail to derive inspiration from it. For students interested in special branches of exact science Ostwald's "Klassiker der exakten Wissenschaften" are available, and for those who require a general view of scientific progress, constructed in the same spirit, Dr. Dannemann's volume is excellently adapted.

We have received vol. xxii. of the *Geographical Journal*, which contains the monthly parts from July to December, 1903. As usual, the volume is remarkable for the large number of its excellent illustrations and for the plentiful supply and high character of the coloured maps. Among many other valuable contributions the following may be mentioned:—the account of the first year's work of the National Antarctic Expedition, by Sir Clements Markham, K.C.B., F.R.S.; the bathymetrical survey of the fresh-water lochs of Scotland, under the direction of Sir John Murray, K.C.B., F.R.S., and Mr. L. Pullar; a scheme of geography, by Prof. W. M. Davis; terrestrial magnetism in its relation to geography, by Captain E. W. Creak, F.R.S.; four years' Arctic exploration, 1898–1902, by Commander R. E. Peary; and the Alaska boundary, by Colonel Sir T. H. Holdich, K.C.M.G., K.C.I.E.

The additions to the Zoological Society's Gardens during the past week include a Vervet Monkey (*Cercopithecus lalandii*) from South Africa, presented by Mr. J. Fisher; a Green Monkey (*Cercopithecus callitrichus*) from West Africa, presented by Mr. H. R. Broad; a Japanese Deer (*Cervus sika*) from Japan, presented by Mr. Leopold de Rothschild; a Common Squirrel (*Sciurus vulgaris*), British, presented by Captain Locock; an Allied Hornbill (*Penelopides affinis*) from the Philippine Islands, presented by Mrs. Johnstone; a Rough-legged Buzzard (*Archibuteo lagopus*), European, presented by Mr. E. A. Maling; two Blue and Yellow Macaws (*Ara ararauna*) from South America, presented by Mr. Charles Storey; two Kestrels (*Tinnunculus alaudarius*), British, presented by Mr. A. H. Bishop; a Hainan Gibbon (*Hylobates hainanus*) from the Island of Hainan, a Variegated Spider Monkey (*Ateles variegatus*) from the Upper Amazons, a Crowned Hawk Eagle (*Spizaetus coronatus*) from Africa, a Blue-rumped Parrakeet (*Psephotus haematonotus*) from Australia, deposited; a Campbell's Monkey (*Cercopithecus campbelli*) from West Africa, purchased.

OUR ASTRONOMICAL COLUMN.

Peculiar Forms of Comets' Tails.—At a meeting of the National Academy (U.S.A.) held at Chicago on November 18, 1903, Prof. E. E. Barnard read a paper dealing with the anomalous appearances sometimes observed on photographs of the tails of comets. Accepting the generally adopted theory that the tails are caused by the repelling action of the sun's light on the cometary particles, he demonstrated that the broken appearance often observed in the tails may be due to the external influence of some resisting medium, possibly groups of meteorites which are in all probability scattered throughout space. Thus the sudden contortions of the tail of Brooks's comet on and after October 22, 1893, might be explained by the supposition that it encountered a swarm of meteorites which caused the extraordinary detachment of the cloud-like masses seen on the photographs obtained between October 22 and November 3. A similar phenomenon might have been produced had the detached portion of the tail of Borrelly's comet (1903), after its separation from the nucleus, encountered any similar resisting medium. Prof. Barnard directs attention to the fact that in the latter case the detached portion gave no evidence of accelerated motion of repulsion such as would be expected if the repulsion were solely due to the action of the sun's light.

Several beautiful photographic reproductions of the various comets discussed by Prof. Barnard accompany his paper in the January number of *Popular Astronomy*.

Actinic Quality of Sky-light.—Mr. Gavin J. Burns has recently published the results of some experiments made by him in order to determine the relative actinic qualities—not intensities—of the light received from the star-lit sky near the zenith on a clear night, of moonlight, of sunlight, and of the light received from the zenith during the day-time.

With ordinary, bright light-sources the usual method of procedure in determining the ratio of actinic to non-actinic rays (*i.e.* the actinic quality) in the total radiation is to analyse the latter, in detail, spectroscopically, but in the experiments performed by Mr. Burns the total radiations were far too faint for the application of this method. He therefore divided the spectrum generally into two parts, actinic and non-actinic, and in order to obtain comparative results used layers of two liquids as screens, the first a solution of bichromate of potash, which totally absorbed the blue, violet, and ultra-violet rays, the second a solution of methyl-violet, which absorbed the orange, yellow and green. In each experiment a layer of known absorptive effect was placed between the photographic plate (Edwards's isochromatic) and the light source. The plate was then exposed to the light for a known period and developed, and then the various results were reduced to standard conditions and compared. From the results thus obtained Mr. Burns concludes that the actinic quality of the light which reaches us from the zenith sky by night, when the sun is at least 18° below the horizon, is greater than that of moonlight from the moon on the meridian, or sunlight when the sun has an altitude not greater than 36°. It is also greater than the average value for the light of the blue, cloudless sky by day. On the other hand, the observations give no information as to the real relative actinic qualities of sunlight and sky-light, for observations of both sources at equal altitudes must be made to determine this ratio (British Astronomical Association *Journal*, vol. xiv., No. 2).

The United States Naval Observatory.—The report of the United States Naval Observatory for the year ending June 30, 1903, contains a general review, by the director, Captain C. M. Chester, U.S. Navy, of the personnel, the work and the results obtained during that period.

Among a number of recommendations as to the future work, the director suggests that subsidiary observatories should be founded on several of the islands governed by the United States in the Pacific. Tutuila, Samoa, situated in lat. 15° S., is especially mentioned in this respect as being generally recognised as an ideal site for an astronomical observatory, and it is suggested that 500 of the 1597 stars adopted at the International Conference of Naval Observatory Directors in 1896 should be observed there by an assistant from Washington, who, with the assistance of the naval officers and men already stationed there, could also make observations of the magnetic elements obtaining on the island.

The director also recommends that one of the ships attached to the European Squadron of the U.S.A. Navy should be deputed to assist a small party of astronomers from Washington in observing the total eclipse of the sun in Spain in 1905. In support of this recommendation he quotes from the report of Sir Norman Lockyer, on the Indian eclipse of 1898, as to the valuable assistance rendered by the officers and men of H.M.S. *Melpomene*, at the suggestion and under the direction of that observer, in making observations of various eclipse phenomena.

Each of the sectional reports has been written by the officer in charge of the particular section reported on, but the results obtained are far too numerous to be given in detail here.

The time service, which operates 18 official time balls and

daily corrects some 40,000 private and public clocks, was efficiently maintained throughout the year with an average error of only 0·15 second.

Radiant Point of the 1903 Leonid Shower.—During a watch extending from 13h. to 17h. on November 14, 1903, two observers at the Ladd Observatory, Providence, Rhode Island, counted 44 meteors, of which 20 were Leonids. Eighteen of the latter were plotted on a chart, and gave a radiant point situated at R.A. = 10h. 1m. ($150^{\circ}·25$), dec. = $+21^{\circ}$ 48′. Under similar conditions in 1901 (November 14, 12h. 35m.–17h. 30m.) 91 Leonids were charted. This difference, not being due to unfavourable meteorological conditions, indicates a diminution in the intensity of the shower for the epoch observed (*Popular Astronomy*, January).

Comparison-Star Photographs for Minor Planets, &c. —In No. 1, vol. ii., of the *Publications* of the Astrophysical Observatory, Konigstuhl-Heidelberg, Prof. Max Wolf publishes a catalogue of the photographs taken by Mr. Dugan during the period 1891–1896.

The catalogue contains plates of the regions which were photographed for the purpose of obtaining comparison stars for minor planets, comets and variable stars, and for each plate it gives the date, the objective used, the region photographed, the designation of the guiding star, and the length of the exposure given.

NAUTICAL EDUCATION IN JAPAN.

A COPY of the prospectus of the Nautical College at Tokio has been received from the director of the college, together with some particulars as to the position of the mercantile marine in Japan. So much attention is being directed to that country at the present time that the following facts are of interest in showing the provision made for the scientific training of officers and men. Before entering into the details of nautical education in Japan, a glance at a statement of the increase of tonnage and number of seamen up to the end of 1902 is instructive.

In the year 1897 the total tonnage of the vessels in Japan did not exceed 400,000 tons, including both steamers and sailing ships; but with the expansion of national industry the number and tonnage of the vessels rapidly increased, and by the end of 1902 the tonnage amounted to 934,961 tons, out of which 605,122 tons relate to steamers and 329,839 tons to sailing ships.

At present, of the skilled officers—mates and engineers—of certified ability handling these ships, 1901 are Japanese and 331 are foreigners. As such is the case, the necessity of training good seamen is urgently felt, and the Japanese Government is paying much attention to nautical education.

In Japan the only organised establishment for training higher seamen is the Nautical College at Tokio. It is attached to the Department of Communications, and the institution was first founded in 1875 by the Mitsubishi Company, but it was transferred to the Japanese Mail Ship Company. In 1885 the school was transferred to and reorganised by the Government, and has grown since up to the condition of the present Nautical College.

The college educates youths destined to become officers of the mercantile marine, that is, it instructs them in theory and practice of matters pertaining to the higher seaman's profession. The course of study is divided into two departments, namely, the department of navigation and that of engineering.

The cadets of both departments are enlisted in the navy during their college life and even after their graduation, and as they are to be appointed as naval officers they have to observe the general laws of the navy.

The classes and curriculum of the navigation department are as follows:—

6th Class.	Seamanship (theoretical). Seamanship (practical) Physics. Mathematics. Modern Japanese and Chinese languages.	Law. Chemistry. Commercial geography. Foreign language. Military drill.
5th Class.	Navigation. Law. Commercial geography. Chemistry. Foreign language. Military drill.	Seamanship (theoretical). Seamanship (practical). Physics. Mathematics. Modern Japanese and Chinese languages.
4th Class.	Navigation. Law. Nautical surveying. Seamanship (theoretical). Seamanship (practical). Marine meteorology. Shipbuilding.	General principles of steam engine. Physics. Foreign language. Mathematics. Nautical hygiene. Military drill.
3rd Class.	Navigation. Nautical surveying. Practical instructions in seamanship. Physics. Mathematics. Economics. Marine meteorology.	Seamanship (theoretical). Shipbuilding. General principles of steam engine. Law. Practical surgery Military drill.
2nd Class.	Navigation. Marine meteorology. Shipbuilding. Economics. Foreign language. General principles of steam engine.	Law. Seamanship (theoretical). Seamanship (practical). Military drill.
1st Class.	Gunnery.	Apprenticeship in far-sea-going vessels.

In this department, navigation, theoretical and practical seamanship, nautical surveying, marine meteorology, law and shipbuilding are regarded as principal studies and the others as auxiliaries.

On entering, the cadets are placed in the sixth class, and are promoted to a higher class every half year; they are instructed in the college class rooms until they advance to the first class, when they are taken to the gunnery school at Yokosuka to be instructed in gunnery for about six months. Then they are to serve their terms of apprenticeship on board several vessels for two and a half years, thus taking five and a half years to complete their education.

In the department of engineering, the classes and curriculum are as follows:—

5th Class.	Steam engine. Drawing. Mechanics. Chemistry. Foreign language. Military drill.	Steam boiler. Shop practice. Physics. Mathematics. Modern Japanese and Chinese languages.
4th Class.	Steam engine. Drawing. Mechanics. Chemistry. Foreign language. Military drill.	Steam boiler. Shop practice. Physics. Mathematics. Modern Japanese and Chinese languages.
3rd Class.	Electricity. Shop practice. Mathematics. Military drill. Steam engine.	Drawing. Mechanics. Foreign language. Steam boiler.
1st Class.	Apprenticeship in engineering practice and in the management of steam engine.	

In the engineering department, steam engine, steam boiler, electricity, drawing and shop practice are regarded as principal studies and the others as auxiliaries.

On entering the department each and every cadet is first placed in the fifth class, and he can rise to a higher class at the end of every six months. He is instructed in the class rooms, as is the case with the cadet of the navigation department. When he advances to the first class he is placed in some factory or yard to receive practical training for two years, and is then taken on board several vessels to serve his term of apprenticeship in engineering for a year, thus taking five years to finish his course.

It is a great incentive for the students that the college sends abroad those graduates who are of promising ability and of good character for the completion of their education.

Any boy above fifteen and below twenty-one years of age is admitted to the college after passing the entrance examinations. The graduates of the Government public or private middle schools, which are acknowledged by the Minister of Education to be on equal footing with the public middle schools, are admitted to the college without entrance examination on their scholarship, provided they receive satisfactory reports as to ability and character from the respective schools where they have graduated.

The cadets are of two kinds, those who are supported by loans from the Government or from some mercantile corporations, and those paying their own expenses. Such students of good character and ability as are deemed by the college authorities to be worthy examples to follow are treated as honorary students, and they are freed from their expenses.

The teaching and administrative staffs of the college comprise sixty-six members, and the total number of cadets undergoing instruction at the college, in workshops, and on board ships is 515.

To practise the cadets in making knots, seigings, splices, hitches, bends, bending and unbending, making and taking in sails, sending up and down yards and spars, a training ship named the *Meiji Maru* is moored in the basin belonging to the college, where the cadets are drilled after their morning class lessons are over. They are also drilled in boating, sailing and steering. The *Meiji Maru* was built at Glasgow, being of 1037·20 tons gross and 457·40 net tons; length 242 feet, breadth 29·25 feet, depth 21·50 feet. The college owns another sailing vessel named the *Kotonoo Maru*, used as a training ship. This was built in London, being 825·32 tons gross and 775·62 net tons; length 161·85 feet, breadth 17·65 feet. The ship is employed in coasting the neighbouring seas.

A large sailing vessel named the *Taisei Maru*, of more than 2000 tons, is now in course of building at the Kawasaki Dock in Kōbe, and when finished it will be used as a training ship in navigating not only to the different ports in Japan, but also to those of Europe, America, Australia, &c.

Besides the Government Nautical College, the Nippon Kaiin Ekisaikwai (Japan Sailors' Home) is to some extent contributing toward the training of higher seamen. The association has branch offices at Tokio, Kōbe, and Nagasaki, where a number of ordinary seamen of some experience are instructed in order to prepare themselves for the examinations to obtain the higher seamen's licenses.

Other public institutions for training higher seamen are the nautical schools at Hakodate, Hokkaido; Oshima, Yamaguchiken; Ochigori, Ehimeken; Mitoyogōri, Kagawaken; Toba, Miyeken; Sagagori, Saga; Toyoda, Hirushimaken. In these institutions navigation and engineering courses are offered. The institutions are open to boys who have finished their four years' course at high elementary schools, and to those who are regarded upon examination as of equal ability. The course is about six and a half years, the lessons being as follows:

Navigation Department.	Moral code.	Reading.
	Composition.	Mathematics.
	Physics.	Chemistry.
	Geography.	Foreign language.
	Drawing.	Gymnastics.
	Elements of surgery.	
	General principles of seamanship, navigation, marine meteorology and shipbuilding.	
	Principles of mercantile marine business.	
Engineering Department.	Mechanics.	Applied Mechanics.
	General principles of electricity.	
	General principles of shipbuilding.	
	Principles of mercantile marine business.	

The graduates of the institution mentioned are required to take the examination for higher seamen, and when they successfully pass it they are made deck-officers or engineers, but the graduates of the Nautical College are granted seamen's certificates without examination.

THE SANDING-UP OF TIDAL HARBOURS.

At the meeting of the Institution of Civil Engineers on January 26 Mr. A. E. Carey read a paper on "The Sanding-up of Tidal Harbours."

The object of the paper was to indicate the effects of sanding-up in harbours situated (1) where no river debouches, and (2) at the mouths of rivers or estuaries. Of the three channels to the Port of Ostend one is now abandoned, and the other two are kept clear by the annual dredging of 950,000 cubic metres. Similarly the Port of Boulogne requires the annual dredging of 535,000 cubic metres. Mr. Carey considers that dredging is the only satisfactory expedient for conserving working depths at the mouths of sand-threatened harbours. Littlehampton is an instance of a permanent harbour at a river-mouth, but the entrance is almost dry at low water. The obliteration of Ceará Harbour, Brazil, a work which occupied ten years and cost more than 400,000*l*., provides an instance of the extinction of a harbour by sand. From a study of the various stages in the construction of the harbour of Madras, it appears that the changes in the contour of the coast which resulted from the first two years' working included a progressive shoaling of the entire area of the harbour up to the original 7½-fathom line. In the opinion of the mixed commission appointed by the Indian Government in 1883, unless the opening of the harbour as designed were closed, and a new opening to the north-east substituted, the harbour would prove valueless as a shelter for shipping.

Referring to the harbours of Denmark, Mr. Carey said that on the west coast the only harbour is that of Esbjerg, and, with this exception, fishing-boats have no shelter except the mouth of the Limfjord. At Hirtshals a Government harbour was projected at a cost of 550,000*l*., and the works were started in 1879. The work is now sanded-up and abandoned, except that the pier has since been prolonged. The utilisation of the Ringkjöbingfjord was advocated, and plans were submitted of an isolated harbour connected by viaducts with the shore at Sandnaeshage, a favourable spot owing to the depth of water there, and the protection of an outlying reef. The Danish Government has now determined on the construction of a small harbour at Skagen, and of two isolated moles, respectively at Hanstholm and Vorupor. In view of the precarious nature of tidal harbour work, a departure from established practice is called for. Harbours of refuge have a limited range of utility, unless in land-locked positions. In a number of instances it would be practicable by means of piled structures to create shipping facilities which would meet reasonable requirements, and come within the resources of local authorities, also avoiding the permanent expense of dredging. Such structures would, however, have to be carefully designed, especially in relation to their height, cranage, and the moorings for vessels frequenting them.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—The following appointments of examiners for 1904 and 1905 have been approved:—In the final honour school of chemistry, Mr. Herbert B. Baker; in the preliminary examination in physics, Mr. Robert E. Baynes; in chemistry, Mr. George B. Croushaw; in botany, Mr. A. C. Seward, F.R.S.

It has been resolved in convocation to confer the degree of D.C.L., *honoris causa*, upon Mr. Henry Wilde, F.R.S., and of M.A., *honoris causa*, upon Mr. J. J. Manley, curator of the Daubeny Laboratory, Magdalen College.

A sum of 1200*l*. has been offered to the university by Mr. Philip Francis Walker for the purpose of founding a studentship for original research in pathology. The studentship will not be confined to members of the University of Oxford. Elections to it are to be made by a board consisting of the Vice-Chancellor, the regius professor of medicine, the Waynflete professor of physiology, the president of the Royal College of Physicians, and Mr. Philip F. Walker. It is not to be awarded by the result of a competitive examination. The studentship is to be tenable for three years, and of the annual value of 200*l*.

In order to avoid the overlapping of practical work in

chemistry done in the various college laboratories and in the museum, a scheme is being tried this term in which each laboratory specialises in a particular subject, and men migrate to the courses they wish to attend instead of remaining in the laboratory to which they are normally attached. Preliminary work is taken at the museum by Mr. Fisher, Mr. Walden, and Mr. Lambert; quantitative analysis by Dr. Watts at the museum and Mr. Manley at Magdalen; organic chemistry by Mr. Marsh and Mr. Sidgwick at the museum; physical chemistry by Mr. Nagel and Mr. Hartley at Balliol; inorganic chemistry by Mr. Baker at Christchurch.

On February 9 resolutions will be submitted to congregation for the purpose of making Greek an optional subject in Responsions for candidates intending to read for the honour school of mathematics or natural science. It is proposed that candidates should offer as a substitute for Greek (*a*) a mathematical subject or a scientific subject, both of which are to be determined by the board of natural science; and (*b*) a modern language, viz. either French or German.

CAMBRIDGE.—His Majesty the King has graciously announced his intention of visiting the university on Tuesday, March 1, on the occasion of the opening of the new buildings for the law school and Squire Law Library, the medical school, the Sedgwick Memorial Museum, and the botanical laboratory.

Dr. H. K. Anderson has been appointed university lecturer in physiology in the place of Prof. Langley.

The regulations for an examination and diploma in tropical medicine and hygiene were approved by the senate on January 28.

AT Bedford College for Women on Thursday, March 17, Dr. J. Lawrence will give a lecture on "Pioneers in Philology."

THE Finance Committee of the Liverpool Corporation has decided to recommend the council to make the municipal grant of 10,000*l*. to the university only on certain conditions, which include inspection and report on the educational methods of the university, an annual report by the university to the council, and the devotion of at least 1000*l*. of the grant to Liverpool scholarships, including the assistance of undergraduates and post-graduates.

THE first conference in connection with the School Nature Study Union was held on January 30 at the Passmore Edwards Settlement, Tavistock Place, London, under the presidency of Dr. Heath, director of special inquiries and reports at the Board of Education. Papers were read by Mr. C. B. Gutteridge, of Alleyn's School, Dulwich, on nature-study in secondary schools and how its claims may be advanced, and by Miss Johnson, on nature-study in a village elementary school.

A LARGE part of the National Library at Turin was destroyed by fire on January 26. The library was housed in the buildings of the University of Turin, and was under the control of the university authorities. It contained 350,000 printed books, of which 100,000 have been lost, amounting in value to half a million francs. The globe constructed by the monk Basso in 1570 has been destroyed. The very choice collections of fifteenth century manuscripts from the Abbey of Bobbio were rescued, and altogether about 1000 manuscripts out of 4000 have been saved in a more or less damaged condition. The university has been closed, as some of the halls give signs of collapsing.

WE learn from *Science* that Syracuse University has received 30,000*l*. from the estate of the late James J. Belden; 10,000*l*. goes to the Medical College and 20,000*l*. to the College of Liberal Arts. Syracuse University also receives the residue of the estate of the late John Lyman. The value of the estate is not stated, but special bequests to charitable institutions were made by Mr. Lyman amounting to more than 30,000*l*. The Catholic University of America has received 10,000*l*. from the Knights of Columbus, and Princeton University has received a bequest of 5000*l*. from the late Louis C. Vanuxem, of Philadelphia. The Clark University has received from Mr. Carnegie 20,000*l*. for a library.

IN connection with the generous gift recently made to the University of London by Mr. Martin White for the encouragement of the study of sociology, a course of eight lectures on "Cities and their Culture-Resources" will be delivered this term by Prof. Patrick Geddes, commencing to-day, February 4. Dr. E. A. Westermarck, lecturer on sociology at the University of Helsingfors, will commence a course of seven lectures on "Early Custom and Morals" on Tuesday, February 9. Both courses will be delivered at the London School of Economics and Political Science. At Prof. Geddes's lecture to-day Sir Arthur Rücker will preside, and will make a general statement with regard to the scope of the Martin White benefaction for the study of sociology.

THERE is a steady and growing demand in the State of Illinois for high school teachers who have had a liberal college training together with a thorough preparation in the special branches which they are to teach. The demand upon the University of Illinois for high school teachers of science has for several years so far outrun the actual supply that places might commonly be found for two or three times the number of competent graduates available. The university has published a circular of information concerning the courses and facilities offered by it to science teachers, so that students and instructors may be generally advised of the facts, and a larger number of capable students may be led to prepare themselves for high school science work. The circular points out that the preparation of a teacher for high school science teaching must consist in part of study of the sciences he intends to teach, in part of the more general study necessary to his liberal education, and in part of the pedagogical studies and experience essential to his immediate success as a teacher.

ON Friday last, Prof. Howard Marsh gave an inaugural address as professor of surgery in the University of Cambridge. In the course of his remarks he said that the changes which had taken place in surgery in recent years were as great as those which had revolutionised so many other departments of human energy. The new starting point consisted in the discovery by Pasteur that many diseases in the vegetable and animal kingdoms were due to the action of minute organisms or bacteria. The next step was the application of Pasteur's discovery to surgery by Lister, who commenced the investigations into the use of substances by which these harmful bacteria might be excluded or destroyed. The thirty years that had since elapsed had been years of revelation and advance in every direction. While the fundamental principle was the same, methods of procedure had undergone rapid development. It had been gradually disclosed to us that there was no organ anywhere in the body which was not amenable to operation, no part which was so constituted or endowed that it could not, under the aseptic method, be treated by surgical interference.

THE annual general meeting of the Association of Technical Institutions was held on January 29. Sir John Gorst was elected president for the ensuing year; and in the course of his presidential address he remarked that the great object of most schools seems to be to make the children still and quiet and orderly instead of having them thirsting for knowledge and eager in its pursuit. The questioning which is natural to children is abolished in favour of a system of answering questions put to them, and in these questions anything like originality or eagerness is at once repressed in the interests of discipline. After a certain time the individuality of a restless, eager, curious child is entirely crushed out, and a stolid, quiet, orderly, stupid class is obtained. The object of all teaching ought to be the development of the general powers of the body and mind of the scholar and not its specific and definite preparation for some particular profession. That comes when it is time to specialise. The spirit of technical instruction—the teaching of the student to do something and to acquire knowledge for the purpose of being able to do something—ought to pervade the whole of our education from childhood to manhood. At the annual dinner of the institution, the chairman, Sir J. Wolfe Barry, referred with satisfaction to the fact that the Royal Society had recently addressed a communication to the universities directing

their attention to the urgent necessity for some reconsideration of the requirements of the universities from secondary schools. The Royal Society recognised, as of course it must recognise, the great importance of the humanities, but it felt that there was something wanting in the career which was insisted upon, especially at the older universities. This induced headmasters of secondary schools to select their most promising pupils entirely with a view to scholarships in classical literature, and to insist upon all the boys in a school spending a great deal of their time in studies for which, no doubt, many of them were fitted, but not all. The Royal Society had done a real service to the country by directing attention to this subject.

THE annual meeting of the court of governors of the University of Birmingham was held on January 28, when the Chancellor, Mr. Chamberlain, presided. During the course of a speech on the motion for the adoption of the annual report, Mr. Chamberlain referred to the question of Government aid for university education. He said, "I should be very sorry to see, in any application which may now or hereafter be made—either to public bodies or to the Government—any idea that that was to dispense individuals from their personal duty in the matter. I think undoubtedly that the Government might make a more liberal response to what individuals have in so many cases done, and nowhere more conspicuously than in Birmingham. When we are dealing with such modern universities as Manchester, Liverpool, and Birmingham, I think it is creditable to the inhabitants of the districts in which they are placed that they should have met so readily the calls upon them, and I think they are almost entitled to demand from the Government a corresponding contribution. But I should myself deprecate any attempt to throw the whole charge upon the Government, and thereby to lose all that we gain by the local patriotism which is evoked, the local self-denial, and the earnest interest which follows upon it. We shall ask the Government, in view of the very great development of this institution, for a larger grant, and we shall be supported by other institutions in the same position." We have on many occasions pointed out in these columns that generous treatment on the part of the State for university education, so far from diminishing private endowments and munificence, causes a marked increase of enthusiasm and generosity among the wealthy merchants and manufacturers. It is a mistaken policy, in a matter of such importance as the provision of facilities for higher education, to urge that Government assistance should only follow private efforts in the same direction, and if our statesmen adopt the working policy outlined by the Chancellor of the University of Birmingham, this country will have to wait a long time for a complete and satisfactory university system. Let the Government set the example and publicly recognise in a substantial manner its sense of the value of higher education, and private enterprise and endeavour will soon be aroused in a corresponding degree.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, January 21.—"On the Structure of the Palæozoic Seed, *Lagenostoma Lomaxi*, with a Statement of the Evidence upon which it is Referred to Lyginodendron." By Prof. F. W. **Oliver** and Dr. D. H. **Scott**, F.R.S. Received December 15, 1903.

The present communication deals with the structure of *Lagenostoma Lomaxi*, a fossil seed from the lower Coal-measures, and with the evidence upon which the authors refer it to the well-known Carboniferous plant, Lyginodendron.

It is found that this species of Lagenostoma, especially in its young form, was enclosed in a husk or cupule, borne on a short pedicel.

The seed, which is of cycladean character, is fully described, and its relation to other fossil and recent seeds discussed.

The cupule enclosing the seed was borne terminally on a pedicel; it formed a continuous, ribbed cup below, and divided above into a number of lobes or segments. Externally, both pedicel and cupule were studded with numerous prominent multicellular glands of capitate form. The anatomy indicates that the whole organ was of a foliar nature.

A comparison with the vegetative organs of *Lyginodendron Oldhamium*, with which the seeds are intimately associated, demonstrates a complete agreement in the structure of the glands and in the anatomy of the vascular system. Where vegetative and reproductive organs, presenting identical structural features, not known to occur in other plants, are thus found in close and constant association, the inference that the one belonged to the other appears irresistible.

As regards the position of the seed on the plant, two possibilities are discussed; the cupule, with its pedicel, may either represent an entire sporophyll or a modified pinnule of a compound leaf. Either view is tenable, but various comparative considerations lend a somewhat greater probability to the second alternative.

In the concluding section of the paper, the systematic position of Lyginodendron is discussed. On the whole of the evidence, the position of the genus as a member of a group of plants transitional between filicales and gymnosperms appears to be definitely established. While many filicinean characters are retained, the plant, in the organisation of its seed, had fully attained the level of a Palæozoic gymnosperm. There are many indications that other genera, now grouped under cycadofilices, had likewise become seed-bearing plants. It is proposed to found a distinct class, under the name Pteridospermæ, to embrace those Palæozoic plants with the habit, and much of the internal organisation of ferns, which were reproduced by means of seeds. At present the families Lyginodendreæ and Medulloseæ may be placed, with little risk of error, in the new class Pteridospermæ.

January 28.—"The Morphology of the Retrocalcarine Region of the Cortex Cerebri." By G. Elliot **Smith**, M.A., M.D., Fellow of St. John's College, Cambridge, Professor of Anatomy, Egyptian Government School of Medicine, Cairo. Communicated by Prof. A. Macalister, F.R.S.

Chemical Society, January 20.—Dr. W. A. Tilden, F.R.S., president, in the chair.—It was announced that the Rev. T. J. Prout had presented to the society a photograph of a portrait by Hayes of Dr. William Prout, F.R.S., the originator of Prout's hypothesis.—The following papers were read:—The chemical reactions of nickel carbonyl, parts i. and ii.: J. **Dewar** and H. O. **Jones**. It is shown that nickel carbonyl is completely decomposed by the halogens, cyanogen and sulphur, carbon monoxide, and the corresponding nickel compounds being produced. With aromatic hydrocarbons of the benzene series, in presence of aluminium chloride, the carbonyl compound condenses to form aldehydes and anthracene derivatives; with naphthalene a complex hydrocarbon is produced. Optically active asymmetric nitrogen compounds, *d*- and *l*-phenylbenzylmethylethylammonium salts: H. O. **Jones**. A microscopic method of determining molecular weights: G. **Barger**. The author has improved his method of determining molecular weights by observing the relative changes in size of a series of alternate drops of two solutions enclosed in capillary tubes, so that the experimental error has been reduced to within 5–10 per cent. Studies in the acridine series, part i.: J. J. **Fox** and J. T. **Hewitt**.—*ortho*-Nitrobenzoylacetic acid: E. R. **Needham** and W. H. **Perkin**, jun.—The *cis*- and *trans*-modifications of $\alpha\alpha\gamma$-trimethylglutaconic acid: W. H. **Perkin**, jun., and A. E. **Smith**.—The influence of substitution on the rate of oxidation of the side chain, part i., oxidation of the mono- and dichlorotoluenes: J. B. **Cohen** and J. **Miller**.—The interdependence of physical and chemical criteria in the analysis of butter fat: T. E. **Thorpe**. Investigation of the butter produced in the United Kingdom has shown that the chemical nature of this fat is dependent on climatic influences, the nature of the fodder, the breed of the cow, the period of lactation, and the idiosyncrasy of the individual cow. Tables of the chemical constants of the butters examined illustrating this are given.—A simple thermostat for use in connection with the refractometric examination of oils and fats: T. E. **Thorpe**.—The condensation of furfuraldehyde with sodium succinate: A. W.

Titherley and J. F. **Spencer**.—The action of heat on α-hydroxycarboxylic acids: II. R. **Le Sueur**. A description of the aldehyde produced by heating α-hydroxystearic acid.—The fusion of *iso*-pilocarpine with caustic potash: II. A. D. **Jowett**. It is shown that the acid produced in this reaction is *n*-butyric acid, and not the *iso* acid as was formerly supposed.—Organic derivatives of silicon: F. S. **Kipping**. A description of the products obtained by the interaction of magnesium alkyl haloids with silicon and alkyl silicon chlorides. Derivatives of highly substituted anilines: F. D. **Chattaway** and J. M. **Wadmore**.

Physical Society, January 22.—Dr. R. T. Glazebrook, F.R.S., president, in the chair.—Notes on non-homocentric pencils, and the shadows produced by them. (1) An elementary treatment of the standard astigmatic pencil: W. **Bennett**. It is shown that several of the properties of the standard astigmatic pencil, and the variations in the form of its cross section, can be simply deduced from a consideration of the projections of its rays upon two planes, each of which is at right angles to one of the two focal lines. The projections of the rays are in each case concurrent. The shadow of a straight wire at right angles to the axis is also dealt with, and it is shown that the rays intercepted by the wire are one set of generators of a hyperbolic paraboloid. The section of this surface by any other plane is a hyperbola or a parabola. The rays are seen to be all parallel to a plane through the axis. If the object wire is not at right angles to the axis the shadow surface is a hyperboloid of one sheet. The section by any plane is, in general, a hyperbola, which is rectangular when the plane is at right angles to the axis and reduces to two straight lines when the plane passes through either of the focal lines. The asymptotes of the rectangular hyperbolas lie in two planes which pass respectively through the two focal lines. The author showed string models of the various pencils and shadow surfaces and of pencils produced by lenses or mirrors. The paper concludes with a simple method for obtaining, by the method of sagittæ, the positions of the approximate lines produced in a small pencil refracted obliquely through a lens.—Some new cases of interference and diffraction: Prof. R. W. **Wood**. In this paper Prof. Wood discusses certain types of the interference of light which have been known for many years, as well as some cases which he thinks are quite new. The colours of mixed plates and the phenomena of interference in transparent films deposited on metallic reflectors are the cases chiefly considered. The facts which have been brought out may be summed up as follows. The colours of mixed plates are due to diffraction, and should not be classed with interferences in their films. The explanation originally given by Young, and the treatment given by Verdet and others, are unsatisfactory, and do not indicate what becomes of the energy. In the cases of films deposited on perfectly reflecting surfaces, which, according to the elementary theory, should exhibit no interference colours, we may, under certain conditions, have colours far more brilliant and quite as saturated as any shown by the soap bubble. In other cases, where at first sight no interference appears to have taken place, we may, by employing polarised monochromatic light, obtain fringes of a very curious nature, which are the result of the interference between the elliptical vibration coming from the metal surface and the plane-polarised vibration reflected from the surface of the transparent film.—On the photographic action of radium rays: S. **Skinner**. It is well known that a photographic plate by exposure to radium rays is affected in such a way that the plate develops similarly to its development after exposure to light. The experiments described in the paper are an attempt to answer the question: Are the actions the same? So far as can be seen, the final results of the actions and developments are the same, and the experiments appear to indicate that only slight differences occur in the early stages.

Entomological Society, January 20.—The 70th annual meeting, Prof. E. B. Poulton, F.R.S., president, in the chair.—It was announced that the following had been elected officers for the session 1904–5:—President, Prof. Edward B. Poulton, F.R.S.; treasurer, Mr. Robert McLachlan, F.R.S.; secretaries, Mr. Herbert Goss and Mr. H. Rowland-Brown.—The **President** delivered an address on the subject of "What is a Species?" What is there to fill the vacancy left by the disappearance of the Linnean conception, founded on "special creation"? In many respects it would be advantageous to abandon the word, or to use it solely with its original logical meaning of "kind," or, as zoologists would say, "form." This view was, however, regarded as a "counsel of perfection," impossible of attainment; and the attempt was made to show that the conception of a naturally and freely interbreeding (or syngamic) community lies behind the usual definitions, and that the barrier between species is not sterility, but simply cessation of interbreeding or asyngamy.

PARIS.

Academy of Sciences, January 25.—M. Mascart in the chair.—On certain doubly periodic solutions of some partial differential equations: Émile **Picard**. On the light emitted spontaneously by certain salts of uranium: Henri **Becquerel**. Some salts of uranium emit light continuously and with an intensity which is greater than would be expected from their radio-activity. The effects are best shown by the double sulphate of uranyl and potassium, and there is a relation between the luminosity and the phosphorescence, since different preparations of this double salt unequally phosphorescent to light are also unequally luminous in the dark. The effects observed are so small that it is necessary for the observer to be in the dark for some time before attempting an experiment. Crystals of the double sulphate exposed to the intense radiation of an electric arc or of a radium salt, and then examined some seconds later in the dark, were no more luminous than specimens of the same salt which had been kept continuously in the dark. The light was too feeble to permit of the examination of the spectrum.—Some new observations on *Piroplasma Donovani*: A. **Laveran** and M. **Mesnil**. This parasite, first found by Dr. Donovan in cases of a fever common near Madras, would also appear to be the cause of a disease known as *Kala-Azar*, or the black fever of the valley of Brahmapootra.—M. Calmette was nominated a correspondant for the section of medicine and surgery in the place of M. Laveran, elected a member in the same section.—The examination of the gases given off or occluded by radium bromide: MM. **Dewar** and **Curie**. A specimen of pure radium bromide was placed in a vacuum in connection with a manometer; gas was found to be evolved at the rate of about 1 c.c. per month, which on spectroscopic examination proved to be hydrogen, most probably produced by the action of the radium compound upon a small quantity of water present. The same specimen, placed in a quartz tube, was heated to redness, any gases given off being removed by the mercury pump. These gases were drawn through tubes cooled down to the temperature of liquid air. The gas which passed through the tube cooled in liquid air was radio-active and strongly luminous, spectroscopic examination of the light emitted showing the three principal bands of nitrogen. The quartz tube containing the radium bromide was then sealed off with the oxyhydrogen blowpipe. Twenty days later M. Deslandres found that the tube gave the complete spectrum of helium, and no other rays could be detected.—On an electrical law of the electrical transportation of dissolved salts: A. **Ponsot**. From the experimental results of M. Chassy, laws are deduced which are in opposition to the hypotheses on which M. Kohlrausch has relied in deducing the molecular conductivity of solutions from the migration numbers.—On certain phenomena arising from physiological sources capable of being transmitted along wires formed of different substances: Augustin **Charpentier**. The physiological radiations, probably identical with the *n*-rays, can be transmitted through a metallic wire as well as through the air. This allows of a much more precise study of these rays from a physiological point of view, one great advantage of the method being that the observer may be placed so far from the sensitive screen as to reduce to a minimum muscular or mental effects foreign to the experiment.—The emission of the Blondlot rays during the action of soluble ferments: M. **Lambert**. The *n*-rays are produced during the action of ferments, the effect being particularly marked for the digestive ferments of albumenoid materials.—On the fluochlorides, the fluobromides and the fluoiodides of the metals

of the alkaline earths: Ed. **Defacqz.** Details are given of the preparation and properties of the barium fluohalogen compounds of the type $BaF_2 : BaCl_2$.—Some colour reactions of molybdic acid: M. Emm. **Pozzi-Escot.** The author has rediscovered the colour reaction between tannin and molybdates which forms the basis of Alexander's method for the determination of lead volumetrically as molybdate.—The electrolysis of chloric acid and chlorates: André **Brochet.** A discussion of the causes of the anomalous results obtained by the electrolysis of chlorates with a copper anode.—On the presence of formaldehyde in atmospheric air: H. **Henriet.** The author has shown in previous papers that there exists in the atmosphere a gaseous substance, which is not formic acid, possessed of energetic reducing properties, capable of reducing Fehling's solution and decolorising iodide of starch solution. By an examination of rain water, proof is now afforded that this reducing substance is formaldehyde, and it appears to be present in proportions between one and five parts per 100,000 of air by weight.—On trichlorisopropyl alcohol: Louis **Henry.** This substance is readily obtained by Grignard's reaction from chloral and methyl magnesium iodide.—On the condensation of acetylenic esters with alcohols: Charles **Moureu.**—On the α-substituted β-methyladipic acids: Marcel **Desfontaines.**—On some derivatives of tetramethyldiaminophenyloxanthranol: MM. **Guyot** and **Stœhling.**—On the formation and saccharification of retrograded starch: L. **Maquenne.**—On the distribution of potash in arable earth: J. **Dumont.**—On a new organism (*Pelmatosphaera polycirri*), the parasite of an annelid (*Polycirrus haematodes*): Maurice **Caullery** and Félix **Mesnil.**—On the necessity of instituting an order of Siphomycetes and an order of Microsiphoneæ parallel to the order of Hyphomycetes: Paul **Vuillemin.**—On the vegetation of some submarine soft water springs of the Lower Seine: Maurice **Gomont.**—On the development of the perithecium of Ascobolus: A. **Dangeard.**—On the geological association of iron and phosphorus and the dephosphorisation of iron minerals by natural metallurgy: L. **De Launay.**—On the magnitude of the nummulitic formation of St. Louis, Senegal: Stanislas **Meunier.**—On the ferment of the disease of wine known as *vin poussé*: J. **Laborde.**—The relation between the interstitial gland and the development of sexual characters: P. **Bouin** and P. **Ancel.**—On the correlation of characters susceptible of natural selection: G. **Coutagne.**—The analytical study of the phenomenon of oscillating life: Joseph **Deschamps.**

DIARY OF SOCIETIES.

THURSDAY, February 4.

Royal Society, at 4.30.—The Reduction Division in Ferns: R. Gregory.—Cultural Experiments with "Biologic Forms" of the Erysiphaceæ: E. S. Salmon.—On the Origin of Parasitism in Fungi: George Massee.—On Mechanical and Electrical Response in Plants: Prof. J. C. Bose.—On the Effects of Joining the Cervical Sympathetic Nerve with the Chorda Tympani: Prof. J. N. Langley, F.R.S., and Dr. H. K. Anderson.—Conjugation of resting Nuclei in an Epithelioma of the Mouse: Dr. E. F. Bashford and J. A. Murray.

Royal Institution, at 5.—Recent Research in Agriculture: A. D. Hall.

Chemical Society, at 8.—The Tautomeric Character of the Acidic Thiocyanates—Preliminary Note: R. E. Doran.—The Resolution of αβ-Dihydroxybutyric Acid into its Optically Active Constituents: R. S. Morrell and E. K. Hanson.

Linnean Society, at 8.—Account of Researches in the Physiology of Yeast: Prof. Sydney H. Vines, F.R.S.—Further Researches on the Specialisation of Parasitism in the Erysiphaceæ: E. S. Salmon.

Röntgen Society, at 8.30.—Discussion on the Production of Photographic Reversal through the Action of Various Radiations.

FRIDAY, February 5.

Geologists' Association, at 7.30.—Annual General Meeting. Address by the President, Mr. H. W. Monckton: on some Examples of the Different Types of Geological Formations, with Special Reference to Recent Excursions of the Association (Estuarine, Lagoon, and Marine Deposits).

SATURDAY, February 6.

Royal Institution, at 3.—Study of Style in Greek Sculpture: Dr. C. Waldstein.

MONDAY, February 8.

Royal Geographical Society, at 8.30.—Turkestan and a Corner of Tibet: Oscar T. Crosby.

Institution of Mechanical Engineers, at 8.—The Work of the Alloys Research Committee: W. H. Merrett. (Graduates' Lecture.)

Society of Arts, at 8.—Oils and Fats—their Uses and Applications. (Cantor Lectures, III.).

Victoria Institute, at 4.30.—Notes on the Volcanic Phenomena of New Zealand: Miss Hilda Boord.

TUESDAY, February 9.

Royal Institution, at 5.—The Development of Animals: Prof. L. C. Miall, F.R.S.

Society of Arts, at 4.30.—The Biology of Federation: Sir John Cockburn, K.C.M.G.

Institution of Civil Engineers, at 8.—Tonnage Laws, and the Assessment of Harbour Dues and Charges: H. H. West.

WEDNESDAY, February 10.

Society of Arts, at 8.—Thermit: its Application to Electrical Engineering: C. Vernon Boys, F.R.S.

THURSDAY, February 11.

Royal Society, at 4.30.—*Probable Papers:* A New Method of Detecting Electrical Oscillations: Dr. J. A. Ewing, F.R.S., and L. H. Walter.—Constant Standard Silver Trial Plates: Edward Matthey.—On Certain Properties of the Alloys of Silver and Cadmium: Dr. T. Kirke Rose.—Sun-spot Variation in Latitude, 1861-1902: Dr. W. J. S. Lockyer.—On the High-Temperature Standards of the National Physical Laboratory. An Account of a Comparison of Platinum Thermometers and Thermo-junctions with the Gas thermometer: Dr. J. A. Harker.

Royal Institution, at 5.—Recent Research in Agriculture: A. D. Hall.

Society of Arts, at 4.30.—Our Commercial Relations with Afghanistan: Col. Sir Thomas H. Holdich, K.C.M.G., K.C.I.E.

Mathematical Society, at 5.30.—On the Roots of the Equation $\frac{1}{\Gamma(x+1)} = c$: G. H. Hardy.—On a Certain Double Integral: Prof. A. C. Dixon.—On an Appropriate Form of Conductor for a Moving Point-Singularity: Prof. A. W. Conway.—On Group-Velocity: Prof. H. Lamb.—On Point-Wise Discontinuous Functions of a Real Variable: Dr. E. W. Hobson.—Some Extensions of Abel's Theorem on Power Series on the Circle of Convergence: G. H. Hardy.

Institution of Electrical Engineers, at 8.—Transatlantic Engineering Schools and Engineering: Prof. R. M. Walmsley.

FRIDAY, February 12.

Royal Institution, at 9.—Westminster Abbey in the Early Part of the 17th Century: the Very Rev. J. A. Robinson.

Physical Society, at 8.—Annual General Meeting. Address by the president, Dr. R. T. Glazebrook, F.R.S.

Royal Astronomical Society, at 5.—Anniversary Meeting.

Institution of Civil Engineers, at 8.—The Electricity and Destructor Station at Plumstead: T. S. Nash.

Malacological Society, at 8.—Annual Meeting: President's Address.

SATURDAY, February 13.

Royal Institution, at 3.—Culture and Sculpture: Dr. C. Waldstein.

CONTENTS.

THURSDAY, FEBRUARY 11, 1904.

EARLY CIVILISATION IN BABYLONIA.

The First of Empires. By W. St. Chad Boscawen. Pp. xxix + 356. (London: Harper and Brothers, 1903.) Price 10s. 6d. net.

THE appearance of Mr. St. Chad Boscawen's book on the "First of Empires" will, we believe, be welcomed by many, and we have no hesitation in saying that it will prove a very acceptable addition to the small library of trustworthy works on Babylonian archæology which is to be obtained in the English language. Mr. Boscawen is well known as a lecturer upon Oriental archæology and antiquities, and especially on the branch of them which brings the student into close relationship with the Bible, and there is no doubt that he has a good, working, first-hand knowledge of the cuneiform inscriptions; this being so, his book possesses a value which is not enjoyed by any other popular work on his subject. And here, before we proceed to criticise the "First of Empires," it will be well to describe its contents briefly.

The chapters in the volume are nine in number, and these are followed by four appendices, which are, in turn, supplemented by a tolerably full index. The first five chapters deal with the beginnings of Babylonian civilisation and the relations which appear to have existed between Egypt and Chaldæa, the next three discuss the life and times of Khammurabi and the famous "Code" of this king, and in his last chapter Mr. Boscawen describes the beginnings of literature. The breadth of the subject which Mr. Boscawen has undertaken to describe in a popular manner is thus considerable, and the examination which we have been able to make of his work convinces us that he has succeeded remarkably well. We must remember that we are dealing chiefly with texts, most of which were written more than four thousand years ago, and even experts are not agreed as to the exact meaning of scores of words which are of frequent occurrence; and, if we confess the truth, sufficient time to digest the immense number of facts which have been recovered during the last few years has not yet been given to Mesopotamian archæologists and cuneiform scholars. For this reason Mr. Boscawen and all other true students of cuneiform literature find it impossible to be dogmatic in the present state of the science of Assyriology, and it is necessary for professors of Semitic archæology to pause before they bid us throw overboard all our preconceived and existing notions on matters of vital interest and importance.

That certain changes of opinion are necessary is very evident, for from Egypt, Babylonia and Assyria have come forth such a great mass of evidence and fact that a careful reconsidering of their mental position is incumbent upon all those who would possess in their minds the true history of the countries which have played such a prominent part in the development of civilisation. Mr. Boscawen's own position is quite pronounced. He comments adversely on the works which, though professedly scientific, actually made the Biblical element predominant, and declared as an axiom that Moses was the author of the Pentateuch; this mischievous system was inaugurated by the late Mr. George Smith, and he was followed by a number of far inferior workers and students, who, not finding the whole of the contents of Genesis in the cuneiform tablets, quickly abandoned the study for one more congenial. All the evidence now available proves that Ezra and his "Great Synagogue" drew largely upon Babylonian legends of the Creation and Flood for the narrative which they re-wrote or "edited," and that Babylonian literature has an antiquity some two or three thousand years greater than that of the writings which are attributed to Moses, and even of the oldest portions of them.

We must now face the fact that the Hebrew text of the Bible has undergone various editings, and we must be content to have the literature of the Hebrews subjected to the same analysis and examination as the literature of any other Oriental people. Mr. Boscawen cites in proof of careless editing, and perhaps of a plurality of authors, the fact that the Hebrew text of the Pentateuch, as it now stands, contains two versions of the Creation Story, parts of two versions of the Flood Story, three versions of the Ten Commandments, and so on. Want of space will not admit even of brief allusions to the fusion of legends of events which took place in Babylonia, or to the various "editings" to which the scribes were compelled to submit the literary works in their hands in order to bring them up to the level of the requirements of their day, but it is quite clear that what went on in the great libraries of Babylonia also went on in the scribes' chambers of the Jewish synagogues in Babylon. When once the reader has made up his mind to these inevitable conclusions, it will be quite easy for him to assign to Eastern archæology its full value in the solving of problems connected with the relations which existed between the Hebrews and the nations round about them, and the whole subject will assume its true proportions on his mental horizon.

In the first chapter of his work Mr. Boscawen treats of the lands of Nimrod, *i.e.* the countries which are commonly called Assyria and northern and southern Babylonia, and in a series of brief paragraphs he shows how the later historic kingdoms were developed from very ancient centres of government which were founded by people who made their way into Mesopotamia from a country lying to the north-east, and who spoke a non-Semitic language. The story of the earliest growth of civilisation in Babylonia forms the subject of the second chapter, and we are led on easily from the time when men were learning to make baskets and mats, and to draw rude figures of animals and objects, to the time when they possessed an elaborate system of writing, and had become consummate sculptors. From the numerous monuments which have been discovered on the sites of several ancient cities in Lower Babylonia, we learn that long before B.C. 4000 the civilisation which had been established in the country by non-Semitic invaders had

taken deep root, and had reached a very perfect state. To illustrate this fact Mr. Boscawen supplies a facsimile of part of the inscription of Manishtusu, King of Kish, with an English translation, and the list of modified picture signs on p. 57 is not the least interesting portion of the chapter. Inserted in the chapter, somewhat oddly it seems to us, comes "The Legend of Creation," and Mr. Boscawen illustrates the old tradition of the fish-headed, man-god Oannes, who taught men to read and to write, and to sow, and to reap, and to build, from the Legend of Adapa. The alleged relation of the Garden of Eden with the grove of Eridu is discussed, and we are glad to see that Mr. Boscawen prints Mr. R. C. Thompson's translation of that portion of the tablet upon which it has been so inadequately based, and that he considers Mr. Thompson has succeeded "to a certain extent"; in our opinion Mr. Thompson's arguments are conclusive and his proofs final, but error dies very hard.

Mr. Boscawen's third chapter deals with the obvious affinity between the primitive civilisation of Mesopotamia and that of Egypt, and he skilfully drives home his arguments with the facts that have been deduced from the excavations of J. de Morgan at Nagada, in Egypt, and at Shushter (*i.e.* Shushan the Fortress, or Susa). Passing over two chapters, we now come to the consideration of the life and times of Khammurabi the Great. A few years ago Mr. L. W. King, of the British Museum, published a valuable monograph on Khammurabi, giving all the original texts from tablets in the British Museum and elsewhere, with English translations; it was tolerably easy to gather from this work that Khammurabi was a ruler of no mean order, but no one ever imagined how great a law-giver he was until the discovery of his famous "Code" by J. de Morgan at Susa. This wonderful document contains about 282 distinct "laws," and we shall hardly be overstating the case when we say that it is fully as comprehensive as the Hebrew Code, which is associated with the name of Moses, whilst it is certainly a thousand years older. It is wrong to say that it is the oldest code in the world, for that which is represented in the so-called Negative Confession of the Book of the Dead is far older. Since the publication of the original text by Father Schiel, many works have appeared on the subject, but the fullest monograph, and one which is of great importance from a comparative point of view, is that by Prof. D. H. Müller, of Vienna, who discusses at great length the relation of Khammurabi's code with that of Moses, and with the Twelve Tables.

For those, however, who lack the time and leisure necessary for comparing modern renderings of this difficult Babylonian text, but who wish, nevertheless, to obtain a good general idea of its contents, we commend the rendering given by Mr. Boscawen in his eighth chapter. The meanings of a number of words which are used in a technical sense are, of course, doubtful, but, speaking generally, the sense of the "Code" of Khammurabi has been well made out. The space at our disposal will not permit us to consider in detail the contents of Mr. Boscawen's chapter on the beginnings of literature, but we may say that the general reader will find in it a large number of interesting facts, as well as extracts from translations of Assyrian texts, made both by himself and by other experts. The book is well illustrated, and will, we believe, be widely read.

BIOLOGY AND ARCHÆOLOGY OF CENTRAL AMERICA.

Biologia Centrali-Americana; or Contributions to the Knowledge of the Fauna and Flora of Mexico and Central America. Edited by F. Ducane Godman and Osbert Salvin.

Archaeology. By A. P. Maudslay. 4 vols. text; 4 vols. plates. (London: R. H. Porter and Dulau and Co., 1889–1902.)

FROM the time of the Spanish conquerors up to our own, a glamour of romance, mingled with hopes of easily gained riches, has hung over the ruined cities of Central America. The fortunate chance that prevented Mr. J. L. Stephens from performing his consular functions in Central America on behalf of the United States Government first gave the modern world a true idea of their character and rendered easier the explorations that have been made during the sixty years that have passed since his account appeared. His book and the drawings of his English colleague, Catherwood, form no unworthy monument to the talents and industry of the two explorers, and will compare favourably with most of the contemporary works in the more trodden fields of archæology.

The modern student, however, is an exacting taskmaster; he realises that no domain of archæology can be profitably studied without reference to others, and he insists upon accurate measured drawings, carefully oriented ground plans, and reproductions by processes that eliminate as far as possible the chance of personal bias or error. Given time, money and intelligent enthusiasm he can obtain all these, though it is but rarely that these conditions have been so harmoniously conjoined as in Mr. Maudslay's "Archæology" in the "Biologia Centrali-Americana." That such a publication as the "Biologia" should have a section devoted to archæology is entirely due to the old friendship subsisting between the author and the munificent editors, Mr. Ducane Godman and the late Mr. Osbert Salvin, who generously offered to include the results of Mr. Maudslay's researches in their magnificent publication. Students of American archæology as well as Mr. Maudslay can only be grateful to them for the elasticity that they have given to their biology. Four volumes containing about 400 plates, measuring 18 inches by 12, and as many volumes of quarto text, admirably printed, represent a whole that few publishers would hesitate to regard as an unprofitable speculation, where the subject treated is American antiquities. Mr. Godman has added another leaf to the crown of English men of science, though it is probable that appreciation will be less in his own country than beyond the Atlantic.

It seems by no means unlikely that the completion of this great work, which has taken fourteen years in the doing, will place the study of the Maya hieroglyphs

and other remains on a surer basis than has heretofore been possible. Mr. Maudslay systematically gives, where possible, photographs of the monuments and inscribed slabs, and, as many of these are injured, puts beside the photograph a careful outline drawing with any restorations for which authority may exist. Thus his plates provide an invaluable *corpus* of Maya inscriptions, absolutely trustworthy on the point of accuracy, which cannot but serve as a starting point for their interpretation. It must not, however, be thought that this monumental work is silent as to the meaning of the hieroglyphs, for a stout appendix of 144 pages contains a detailed explanation of their purpose and meaning. This contribution is not from the pen of Mr. Maudslay, but is written by Mr. J. T. Goodman, a Californian enthusiast on the subject of Maya history. From his too modest preface we gather that he has spent twelve years in conjunction with Dr. Gustav Eisen, of San Francisco, in this study, and that the present work is only a preliminary sketch, written expressly to accompany Mr. Maudslay's work.

Mr. Goodman has but little respect for the methods of those who have, or should have, attempted the interpretation of the mysterious writings, and his position may be stated in his own words, that he has lost confidence in the ability of learning, but retains faith in the genius of ignorance. Such a confession may act as a deterrent or an attraction; but its candour and courage are manifest. Mr. Goodman writes of the "Archaic system" found at Palenque, Copan, Tikal and elsewhere, that "all the inscriptions so far brought to light are of a purely chronological character, destitute of any real historical importance." This of itself is no mean discovery, if further research should confirm it, and it must be confessed that the elaborate tables here published have been extensively used by subsequent workers.

It is impossible here to do more than state that from the external evidence, Spanish and other, Mr. Goodman's scheme is probable. One of his fixtures may be mentioned to give an idea of the vast sea of chronology on which we are embarked, viz., that the period chronicled in the existing Maya inscriptions was the beginning of the last quarter of their grand era, marked by the observance of its 280,000th year! Truly the New World is the older one, and instead of looking for the origin of American civilisation on this side of the world we should try the other way about. Whether or no the ancient culture of the American continent is indigenous is a question not likely to be answered in our time. The one point on which all are agreed is that if any connection or influence existed it must have been at a time so remote that geological rather than chronological methods of computation must be invoked.

It is, therefore, somewhat childish to insist upon small coincidences, the occurrence of particular patterns and the like. The existence of the oriental game of *pachisi* is certainly a remarkable fact and worthy of note, and the resemblances in style between the architecture of Egypt and that of Central America are equally so. But all primitive folk have games, and the evolution of *pachisi* in two independent centres is conceivable; while the architecture both of Egypt and of ancient America is, after all, little more than the piling of stone upon stone. The decorative part of the buildings is another matter. If, however, it could be shown that there was an identity of method in computing time between the Maya and any of the nations of antiquity in the eastern hemisphere, that would be truly a step towards fulness of knowledge. One point related to such matters has, as a matter of fact, been already satisfactorily determined, viz., the identity of orientation of temples in Yucatan and in Egypt, pointing to sun-worship at the same seasons and the use of the same northern stars in both countries, according to Sir Norman Lockyer. Here truly is a good solid basis for relations or communication between the two, and so good a starting point should prove fruitful both of accurate observation in the future, and show the direction that serious investigations should take. It is to the United States that the world naturally looks for sustained efforts to solve the archæological problems of Central America, and there are many signs that well-equipped students will not be wanting. Meanwhile, England may justifiably take pride in having produced the most important book on the subject, while Mr. Maudslay is to be congratulated on the completion of a *magnum opus* involving so great an amount of personal labour—a labour of love it certainly was—and on the possession of a friend like Mr. Godman to put his results before the public in so worthy a guise.

FRICTION IN MACHINERY.

Friction and its Reduction. By G. U. Wheeler. Pp. viii + 171. (London: Whittaker and Co., 1903.) Price 3s. net.

A Treatise on Friction and Lost Work in Machinery and Mill-Work. By R. H. Thurston. Pp. xi + 425. (New York: J. Wiley and Sons; London: Chapman and Hall, Ltd., 1903.) 7th edition. Price 3 dollars.

MR. WHEELER'S book is a reprint in the main of a series of articles contributed by the author to a technical journal, but a considerable amount of new matter has been added; it deals fairly completely with the subject of friction in machinery and the means adopted for its reduction. The first two chapters are devoted to a discussion on the importance of the subject from a mechanical engineer's point of view, and to brief statements of the laws of solid, rolling, and fluid friction. Then follow a series of chapters bringing together in a very convenient form for reference all the experimental work on the subject of friction likely to be of value to those engaged in the design of machinery.

We would point out, however, that the author has failed in several cases to give exact references to the original sources from whence his tables and other data have been obtained; this is unfortunate, as very often those making use of the book will be anxious to refer to the original memoirs. Some account is then given of the physical properties, such as specific

gravity, flash point, temperature of solidification, &c., of the most important of the oils now used for lubricating purposes, and a description of the apparatus commonly employed in connection with their determination.

Though the illustrations are, as a rule, clear enough, there are a few instances where it is difficult to follow the author's description of pieces of apparatus owing to the fact that symbols used in the letter-press description are not printed on the corresponding illustration.

After a brief description of the various appliances used in connection with the distribution of the oil to the working parts of machines, the author discusses the comparative value of various lubricants from the point of view both of cost and of suitability for different classes of work. Ball-bearings and roller-bearings are dealt with in two chapters, but this part of the book is by no means so complete as the earlier portions; the last chapter, which explains "forced" lubrication, might with advantage be considerably extended in any new edition. The book, however, will be found very useful for reference purposes, both by those engaged in the design and by those who have charge of machinery on a large scale; information previously scattered through various publications has been brought together into a very compact form.

The fact that Prof. Thurston's book has now reached its seventh edition is a proof of how well it has done its work in spreading among engineers a knowledge of the importance of sound investigation into the energy losses brought about by friction and the best means of lessening them. The author, whose death we had so recently to deplore, has added much fresh matter in this new edition, and brought up to date the chapters dealing with experimental investigations on friction. In the additions Prof. Thurston describes the latest researches in regard to friction in high speed electric generators and motors, and in turbines; the experimental work of Lasche is summarised very fully and clearly, and his graphical methods of recording the results of various experiments by the three coordinate system are explained, the three coordinates being pressure, velocity and temperature of lubricant. The chapters dealing with lubricants and the best methods of testing them have also been considerably revised, and amongst other additions we notice several sections treating of roller and ball bearings. The book is now probably the best reference work on friction at the disposal of engineers engaged in the design of machinery.

T. H. B.

THE FLORA OF THE SWISS ALPS.

Geschichte und Herkunft der schweizerischen Alpenflora. By M. C. Jerosch. Pp. vi+253. (Leipzig: W. Engelmann, 1903.) Price 8s. net.

THE attempt to trace the origin of a flora is so much a matter of speculative argument that it is only natural to find very divergent opinions expressed by different authorities. The object of this book is not to offer a new theory regarding the origin of the flora of the Swiss Alps, but to bring together the views which have been put forward by leading botanists, partly for reference, partly with the object of comparing them and criticising them so far as it is possible to criticise the evidence of experts.

The primary basis upon which to formulate hypotheses is obtained by a comparison of the flora of the Swiss Alps with the floras of other regions in which many of the same plants are found. The occurrence of similar forms in the Arctic and Alpine regions is well known, and from the appearance of the species in different mountainous or Arctic regions it is possible to separate them into groups, such as the Arctic Alpine, the mid-European-Alpine group, and so on. The next step is to consider where these forms may have originated. Take, for instance, a form which appears in the Arctic regions, in the Altai Mountains, and also in the Swiss Alps. Was the original progenitor a native of any of these districts, or even elsewhere? By what path did it travel from one locality to another, and when? Some information may be gained by consulting geological records, and for this purpose the salient features of the post-Tertiary formations are submitted. A most important consideration is the effect of the Glacial period, whether the conditions were too severe or whether a portion of the present Alpine flora could have existed during the Glacial epoch; this has an important bearing on the age of the endemic species in the Alpine flora. On this, as on all hypothetical points, there is a great diversity of opinion. Christ, Heer, and Schröter are amongst those who favour a pre-Glacial origin, but Schulz, Nathorst and Clement Reid hold the view that vegetation was very much reduced at the best during the Glacial period.

Then follows the most difficult because the most speculative question, which refers to the original home of these plants. To consider again those forms which have now found suitable conditions in such scattered and diverse areas as the Arctic regions, the Alps, and the Altai Mountains, the Arctic region is postulated as the original source by Heer, Chodat and Pokorny; Hooker regards Scandinavia as the probable original home; Christ refers them back to the temperate regions of northern Asia, and considers that the Arctic regions merely represent the line of travel; and finally Briquet offers an entirely different solution, since he favours the possibility of the same species having originated in more than one locality.

These examples will give some idea of the complex and difficult problems which confront the systematist who endeavours to unravel the past history of even a highly specialised flora, and will indicate how widely diverse are the explanations which are offered by well qualified investigators. It will be inferred that the writer has had no easy task in stating briefly and impartially the various arguments. To weigh up definitely the pros and cons is impossible, but the criticisms of the author are very fair, and display considerable acumen. The scope of the book is indicated by the fact that the bibliography covers ten pages, and not the least interesting chapters are those which discuss the origin of species and the climate of the Alps.

OUR BOOK SHELF.

The Planning and Fitting-up of Chemical and Physical Laboratories. By T. H. Russell, M.A. Pp. xx+178. (London: B. T. Batsford, 1903.) Price 7s. 6d. net.

The young college graduate at the present time frequently finds himself confronted with the problem of installing a science laboratory in the school which he may have chosen as the scene of his first teaching experience. The laboratory in which he has been working has, it may be, developed through various stages of incompleteness into an institution capable of supplying his every want, whether in the form of apparatus or of other equipment. The student has, however, in most cases taken but little part in this gradual evolution, and in general feels greatly at a loss if compelled afterwards to work in some institution less elaborately equipped. Still more difficult is his task if called upon to equip a new laboratory, and perchance in a building which the architect has most satisfactorily designed for any purpose but that of a science laboratory. Much assistance can be gained by those placed in such a position from the excellent little book before us, which deals in a practical manner with the general design and equipment of an elementary, chemical, or physical laboratory. Dimensioned drawings are provided of suitable working benches and other fittings, and in addition, useful notes as to the best manner in which to apportion the space available.

For the satisfactory planning of a university or college laboratory, considerably more experience than can be gained from a book of this kind is, of course, necessary. The author seems to have noted carefully the best practice in some of our own more recently equipped institutions, but has made some rather curious omissions which one would be glad to see remedied in future editions of the book. What physical or even chemical laboratory at the present day is complete without a satisfactory electrical equipment? The design of the most suitable and convenient system of distributing the electric current to different parts of the laboratory is one of the most difficult problems which have to be faced. Yet the author makes absolutely no mention of such fittings, neither does he give even general hints which would be of guidance in this matter.

It is, moreover, to be regretted that no use is made of Continental experience, which, in the matter of laboratory equipment, is really very valuable. Since, in Germany, it is the custom to publish full descriptions of any new and important laboratory, it would have been a very simple matter to at least refer to such literature. The new chemical laboratory of Prof. Emil Fischer in Berlin makes a particularly valuable study to anyone dealing with laboratory design, the completeness and elegance of the installation being probably unique so far as a teaching institution is concerned.

However, so much that is good can be found in the book that it is almost ungrateful to point out such omissions. R. S. H.

The Highlands of Bukhara. Part ii. Hissar, the Range of Peter the Great, and the Alai. St. Petersburg, 1902. By V. I. Lipskiy. Pp. 220; with 18 plates (Russian).

This is a new volume of the fine series of works on Central Asia published by the Russian Geographical Society. M. Lipskiy describes in it his journey across the western portion of the beautiful snow-clad Hissar Range, then the valley of Kafirnagan and the Surkh-ob, which flows at the southern foot of this range, and finally the range of Peter the Great, which runs parallel to the former, south of the Surkh-ob. This last range M. Lipskiy crossed four times, following three different passes, and he explored in more detail the picturesque region of glaciers in the eastern portion of the range, east of the Gardán-i-kaftár Páss. Three great glaciers, to which the traveller gave the names of Borolmáz (from a peak of the same name), Peter the Great's, and Oshánin's (from the first explorer of this range), are described in detail, and the descriptions are accompanied by excellent photographs. It is sufficient for the glacialist to cast a glance at some of these photographs in order to say that the present glaciers must be but small remains of a much greater glaciation, and that the valleys they now occupy must have once been filled deeply with ice. This is also the opinion of M. Lipskiy, who has discovered immense moraines across the upper valleys and other traces of a wide glaciation. The altitude of the range of Peter the Great seems to be less than it was supposed to be, namely, about 17,000 feet. That the Alai Range is a continuation of the Hissar Range can now be taken as certain, and consequently the range of Peter the Great must be a continuation of the Trans-Alái, a border-range of the western, Bukhara portion of the Pamir plateau. Traces of upheavals in a direction N.W. to S.E. seem also to exist. Throughout, in describing his mountaineering, M. Lipskiy gives lists of the plants he saw. P. A. K.

The British Journal Photographic Almanac, 1904. Edited by Thomas Bedding. Pp. 1604. (London: Henry Greenwood and Co.) Price 1s. net.

Like its predecessors, this volume is of considerable thickness, containing no less than 1604 pages. It is the forty-third yearly issue, and as usual contains a veritable mine of useful information which should appeal to every photographer. When so much matter is involved, it is difficult to refer to one subject more than another; attention, however, may be directed to the "epitome of progress," compiled by the editor, which contains an excellent *résumé* of the more important papers published throughout the past year. The main portion of the text matter is devoted to numerous short articles on miscellaneous photographic topics, tables of all descriptions, and a most complete collection of photographic formulæ and recipes. A great number of illustrations are scattered among the text, and the volume contains a mass of advertisements handy for reference. The fact that the 25,000 copies forming the edition were fully ordered several weeks before publication speaks volumes for the popularity of this book.

Erdmagnetismus, Erdstrom und Polarlicht. By Dr. A. Nippoldt, jun. Pp. 136. (Leipzig: G. J. Göschen, 1903.) Price 80 pf.

This volume, which is No. 175 in the excellent "Sammlung Göschen," well maintains the high standard of the series. It is difficult, indeed, to see in what way these tiny volumes could be improved. Most careful pruning must have been exercised by each author, and the result is a concise, compact summary of present-day knowledge. The subjects of the chapters are the magnetic elements, the permanent magnetism of the earth, the variations of the earth's magnetism, earth currents, and the aurora. The variations are illustrated by diagrams, and include secular, daily and annual variations and their theory, magnetic storms, the eleven-year period, and influence of the sun, moon and planets.

There are three plates showing magnetic distributions.

For mathematical theory reference is made chiefly to vol. lxxviii., "Theoretische Physik," in the same series. There is a sufficient literary summary provided.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

Science at Oxford and Cambridge.

I HAVE read with great interest Prof. Perry's article on "Oxford and Science" and his letter in NATURE of January 21, and assuming as I do that his remarks apply equally to Cambridge, I know that he has in no way overstated his case. There are one or two effects of the present system which I feel that he has scarcely brought out sufficiently strongly, and on which I lay the more stress, as I consider that they are harmful in more ways than one.

I well know the asphyxiating atmosphere of which he speaks, and I compare it to that of a septic tank the contents of which are reduced in time to the form of an innocuous but useless effluent. Had they been spread out over the country at large they would have been of value in raising up a fertile growth of scientific progress.

The university professor is generally in a position to disregard the apathy of his university, and to pursue researches for their own sake. In the case of the enthusiastic student who is desirous of embarking on a career of teaching combined with research, the effects of the present system are far more deadly, especially if he belongs to a small college where the mediæval atmosphere is usually most concentrated.

In the present day it is generally impossible, and if possible it is always highly inexpedient, that a man should devote his energies to research, pure and simple, without taking some part in the educational work which is being carried on all around him. But the man who, after taking a brilliant degree *in arts or science*, seeks to associate himself with the teaching and examining work of his college or university, frequently finds himself baulked at every step by the opposition of a hostile but influential *clique*, although he is being continually urged by his friends to remain at the university in the hope that he may ultimately obtain that recognition which is freely conferred on men of less originality. Although the dons of his college will not raise a finger to help him, they do everything in their power to dissuade him from engaging in such outside work as a man without teaching experience has a reasonable prospect of obtaining in these days of competition. When a good professorship falls vacant, they write testimonials belauding his original work, of which they know nothing, but his candidature breaks down as soon as questions are asked about his teaching experience.

[A striking contrast to this spirit is seen in the excellent work done by certain well organised departments, such as the Cavendish Laboratory and a few enlightened colleges.]

What I have attempted to describe is not the experience of a single individual; from the number of cases that have come before my notice I feel sure that it must be a common experience.

I now pass to the other side of the question. When a vacancy occurs in a university college, it frequently happens that there is one candidate whose brilliant distinctions place him far above his rivals, and whose appointment would *in all probability* greatly conduce to the success and welfare of the department of which he would have charge. The electors would gladly appoint him if *any* definite evidence could be adduced as to his capability of discharging the duties required of him, but failing such evidence they are obliged, after a long and protracted discussion, to choose the second candidate on their list.

I know men who have broken through the barrier, both from Oxford and from Cambridge. I am glad to have such men as colleagues, for I know that they are doing splendid work in raising up a high standard of university education throughout Greater Britain.

Our university colleges have not been afraid to establish scholar assistantships in departments in which the work is too heavy for the existing staff. Why should not the same procedure be adopted at Oxford and Cambridge? This would often enable the colleges to give their best graduates a good send-off into the world, and it would relieve the present teaching staffs of much burdensome routine work. We might even have college tutors waxing enthusiastic over scientific research! G. H. BRYAN.

The Radiation from an Electron moving in an Elliptic, or any other Orbit.

I HAVE been looking for a tolerably simple way of expressing the radiation at a distance from an electron, to avoid the work involved in reducing the general formulæ (NATURE, November 6, 13, 1902) in special cases. The result is

$$\mathbf{E}=\frac{\mu Q}{4\pi r}\ddot{\mathbf{s}}\sin\gamma, \qquad (1)$$

subject to

$$R=v(t-t_1). \qquad (2)$$

Here understand that Q is the charge moving in the path defined by the vector $\mathbf{s}$ from the origin at the moment t_1, and $\mathbf{E}$ is the electric force at the corresponding moment t at the point P at the end of the vector $\mathbf{r}$ from the origin, at distance R from Q, and γ is the angle between $\mathbf{r}$ and $\ddot{\mathbf{s}}$. That is, the electric force is the tangential part of the vector $\ddot{\mathbf{s}}\mu Q/4\pi r$, or the part perpendicular to $\mathbf{r}$. The magnetic force is perpendicular to $\mathbf{E}$, given by $E=\mu v H$. It is assumed that s/R is very small, but no assumption has been made about u/v, so the waves are fully dopplerised. The dot indicates time-differentiation at P.

Example. Elliptic orbit. Let

$$\mathbf{s}=\frac{1}{n}\left(\mathbf{i}u_2\cos nt_1+\mathbf{j}u_1\sin nt_1\right). \qquad (3)$$

Then Q describes an ellipse in the plane x,y, axes u_2/n and u_1/n, where $n/2\pi$ is the frequency. It is the spring or pendulum kind of elliptic motion. Describe a spherical surface with centre at the centre of the ellipse, and project $\mathbf{s}$ upon the surface, and insert the result in (1). Then we get

$$E_\theta=\frac{\mu Q}{4\pi r n}\cos\theta\frac{d^2}{dt^2}\left(u_2\cos\phi\cos nt_1+u_1\sin\phi\sin nt_1\right), \qquad (4)$$

$$E_\phi=\frac{\mu Q}{4\pi r n}\frac{d^2}{dt^2}\left(u_2\sin\phi\cos nt_1-u_1\cos\phi\sin nt_1\right), \qquad (5)$$

expressing the θ and ϕ components of $\mathbf{E}$ at the point r,θ,ϕ, if θ is measured from the z axis, and ϕ from the plane z,x.

Yet one thing more. The connection between t and t_1 is

$$nt_1=n\left(t-\frac{r}{v}\right)+\frac{\sin\theta}{v}\left(u_2\cos\phi\cos nt_1+u_1\sin\phi\sin nt_1\right), \qquad (6)$$

which gives

$$\dot{t}_1=\left\{1-\frac{\sin\theta}{v}\left(u_1\sin\phi\cos nt_1-u_2\cos\phi\sin nt_1\right)\right\}^{-1}, \qquad (7)$$

which is required when (4) (5) are differentiated. This process introduces the factor $\dot{t}_1^{\,3}$, and so, at high speeds, converts the radiation into periodic pulses, as in the case of a circular orbit (NATURE, January 28, p. 293). Put $u_1=u_2=u$ in the present formulæ to reduce to the circular. The analysis to simply periodic vibrations may be done in a similar way. If the motion in the elliptic orbit is of the planetary kind, the equation (3) is replaced by a much less manageable one. Electrons can conceivably vibrate in both these ways, according as the centre of force is condensed positive electricity, or is the centre of diffused positive electricity.

This is not the place for detailed proofs, but I can indicate one way of representing the matter which has some interest apart from the speciality of orbital motion. Given that Q is moving anyhow, it may be shown that my general formula for $\mathbf{E}$ may be converted to

$$\mathbf{E}=\frac{\mu Q}{4\pi}\ddot{\mathbf{R}}_1+\frac{\mu Q v}{4\pi R^2}\left(\dot{\mathbf{R}}-3\dot{R}\mathbf{R}_1+v\mathbf{R}_1\right) \qquad (8$$

This gives $\mathbf{E}$ at P, at distance R from Q, and $\mathbf{R}_1$ is the unit vector $\mathbf{R}/R$. The centre varies as we shift P, because Q is moving. It is always to be understood

that Q and P are at every moment of time uniquely connected when $u<v$. Any value given to t fixes a corresponding value t_1 for Q, and its position as well. This formula (8) is a very curious way of representing $\mathbf{E}$, and physically very unnatural. But the form of the first part is such that it leads easily to the radiational formula above given. Reject the second part of $\mathbf{E}$ in (8), because it varies as R^{-2}. Then carry out d^2/dt^2, and reject the R^{-2} part again. There is left

$$\mathbf{E}=\frac{\mu Q}{4\pi R}\left(\ddot{\mathbf{R}}-\ddot{R}\mathbf{R}_1\right). \qquad (9)$$

Lastly, put $\mathbf{R}=\mathbf{r}-\mathbf{s}$; then $\ddot{\mathbf{R}}=-\ddot{\mathbf{s}}$; and if s/r is very small, $\ddot{R}=-\ddot{\mathbf{s}}\mathbf{r}_1$. So we come to the formula (1) above, as required. I hope this will be satisfactory. If not, there are lots of other much more complicated ways of doing the work.

OLIVER HEAVISIDE.

January 28.

Corrections in Nomenclature: Orang Outang; Ca'ing Whale.

KINDLY allow me a line or two in NATURE to point out that *Orang outang* is not the correct designation for the large anthropoid of Borneo and Sumatra, although it has now obtained, perhaps, what may seem a prescriptive right in our language. Nevertheless, it is as well to be accurate as not. *Orang utan* (or *outan*, if preferred), the correct Malay name for this ape, signifies (as is well known) *Orang*, man, and *utan*, forest, *i.e.* the forest man, in contradistinction to the *Orang dusun*, or village (civilised) man. *Orang utang* (or *outang*) is nonsense. *Utang* means *debt*, something *owing*. The correction has been made often before, but the occurrence of the erroneous combination in the latest abstract of the *Proceedings* of the Zoological Society and in a recent zoological work induces me to venture, in the interest of accuracy and of those who understand the Malay language, again to direct attention to the proper spelling.

In a previous issue of NATURE (March, 1901) you kindly afforded me space to point out the erroneous use also of "*ca'ing*" for "*ca'in*," as the Anglicised (or Scotticised) appellation for *Globiocephalus melas*. My friend Sir H. H. Johnston, I observe, in his recent elegant work on British mammals uses "ca'ing whale." I hope he will accept this small correction for his second edition. Ca'in is, of course, really equivalent to "call in." "Call" in the Scottish vernacular = ca' = drive: the "drive in" whale. Here the use of "ca'ing" = calling would be inappropriate, as the *whale* does not "call," either in the sense of "bellow" or "drive." If, however, it be argued that "ca'ing" does stand for "calling," the essential word "in" is omitted, and ought to be supplied. The pilot whale is the species, which in the islands to the north of Scotland so frequently occurs in large "schools," when it is invariably "driven in" for capture on the shore by a surrounding fleet of boats.

HENRY O. FORBES.

Museums, Liverpool, January 30.

Strange Winter Scenes connected with Lough Neagh.

AT the close of the long frost in February, 1895, strange phenomena occurred in connection with Lough Neagh, in the north of Ireland, the largest lake in the United Kingdom, and one of the larger ones of Europe, covering as it does an area of upwards of 150 square miles. The lake had been frozen over for a fortnight, and thousands of people had indulged in skating on ice almost as smooth as glass.

On February 22, the last day but one of the skating, though unknown to the multitudes gathered near Antrim, the ice in the central portion of the bay broke up, but left intact a sheet of about a third of a mile wide along the south-eastern shore. At a point about six miles from Antrim, this unbroken shore portion was at intervals of a few yards for a mile and upwards raised into little tunnels or bridges, from beneath which pieces of ice, large and small, along with some boulder stones of considerable size, were shot on to the land, eventually forming a ridge varying in height from two to fourteen feet, and perhaps twenty feet broad at the base. The jingling and crashing heard during the operation, which lasted for two days, were very great, and to some persons residing near most alarming. Ice has often been seen piled up along the shore at certain points, five or six feet high, but this has been shore ice thrown up by waves, whereas the ridge referred to was not shore ice, that, as stated, remaining unbroken for a third of a mile out.

I met with only one person who had witnessed a similar scene to the one described. She had resided near the lake all her life, and remembered the long frost of 1814–15, when the lake was frozen over and a great ice ridge was thrown up. On both occasions a person could walk along the road near the lake and yet not see it, in consequence of the intervening ridge. Where did the ice forming this ridge come from? And what was the force employed to convey it to, and shoot it on to the shore?

At a spot on the same south-eastern shore of Antrim Bay, about midway between that previously mentioned and Antrim, a similar scene in one respect, but on a greatly reduced scale, was witnessed. A man when passing along a lonely, wooded part of the road, at a considerable distance from the lake, heard great hissing and fizzing, in a jerky, intermittent manner. On making his way through the underwood to the place from whence the sounds proceeded, he was astonished to see a large stone, estimated to be several hundredsweight, being ejected from beneath the raised ice, and at the same time large quantities of water squirted from the apertures near it. Immediately the propelling force ceased, the stone fell back and the squirting stopped. It was somewhat risky to venture near, but three persons did so to see if they could withstand the propelling force of the water giant, but they found the effort ineffectual, and got drenched for their pains. Through some obstruction, or the stone being too heavy, it was not ejected from the lake.

It would be interesting to know the causes of these phenomena, and also whether they have been observed in connection with lakes elsewhere.

If further information is desired by any reader interested in this matter, I shall be happy to give it if able.

The Manse, Antrim, January 26. W. S. SMITH.

The α Rays of Radium.

IN Mr. Soddy's article on radio-activity in your issue of January 28, he remarks as peculiar the fact that the α rays possess the "property of being more difficult to deviate for any given strength of field the greater the distance of air traversed." Surely if these rays consist of positively charged material particles, their velocity must diminish in proportion to the distance of air traversed, and hence their magnetic effect, and consequently their deviability, must diminish also.

I have unfortunately missed Prof. Rutherford's proof as to the probable difference in speed with which the α particles from the successive disintegrations are shot off. Could Mr. Soddy supply the reference, as there seems no obvious reason why this should be so?

J. T. NANCE.

Bromsgrove School, Worcestershire, February 2.

IT is true, as Mr. Nance points out, that the velocity of the α rays may be expected to diminish in proportion to the distance of air traversed, and it follows, therefore, that the magnetic deviability should correspondingly increase, for the displacement experienced by the particle in unit time by a constant magnetic force from the position it would occupy if no force were acting is constant. With diminishing velocity the displacement in unit distance, and therefore the angular deviation, must increase.

The complexity of the α rays of radium was referred to by Prof. Rutherford in his paper in the *Phil. Mag.* for February, 1903, in a footnote to p. 184. Only 25 per cent. of the α rays come from the radium, the remainder originating from its successive disintegration products, viz. the gaseous emanation and the matter causing the excited activity. As these three types of matter have no resemblance whatever in their material nature, it would be a remarkable coincidence if the α particles expelled in their several disintegrations happened to possess the same momentum in each case. This is the condition necessary for the α rays of radium to be deviated as a homogeneous pencil in a magnetic field.

FREDERICK SODDY.

Coloured Haze around the Moon.

All last night there was a very strongly marked circular space of hazy reddish colour about the moon of about 20° radius; towards morning (2 to 4 a.m.) the colour was most pronounced.

The weather was very fine all night, the temperature being about 20° F. and the humidity from 30 to 40 per cent. There was very little haze in the lower atmosphere, the snow on the hill-tops being silvery white to the verge of the horizon, about 50 miles distant. Immediately above the horizon to S.W. there was, at 3 and 4 a.m., a belt of dark copper-coloured sky, the upper edge of which (at 3 a.m.) just touched the lowest part of the coloured space round the moon. There was some cirrus about the moon at times, and on this part of a halo was faintly marked at 2 and 3 a.m. At 4 a.m. filmy cirro-stratus radiating from the south was more general, and the halo was almost complete. The above phenomenon, however, seemed quite different from the ordinary cirrus haze, and so far as could be observed had no trace of either halo or corona connected with it.

Angus Rankin.

Ben Nevis Observatory, February 1.

THE NEW EDUCATION AUTHORITY FOR LONDON.

By the provisions of the Education (London) Act, 1903, which comes into operation on May 1 next, the control of the education of London becomes a duty of the London County Council. After that date education in London is to be administered as an organic whole and is no longer to consist of separate, unrelated parts. In place of the London School Board administering the elementary education given in schools provided by the ratepayers, the London Technical Education Board regulating the instruction given in accordance with the Technical Instruction Acts, and the governing bodies supervising the work of various grades of secondary schools for boys and girls, the London County Council becomes the authority for the whole of London's education elementary, secondary, technical and higher.

The Act which brings about this complete and momentous change enacts that the Council shall establish an education committee in accordance with a scheme made by the Council and approved by the Board of Education. Chiefly with this object in view the London County Council, on November 10 last, referred the Education (London) Act, 1903, to its General Purposes Committee to advise as to the practical steps to be taken for the administration of the Act. This committee reported to the Council at its meeting held on January 26, and the report, containing suggestions as to the constitution of the Education Committee which were adopted by a large majority of the Council, deserves the earnest attention of all who have at heart the educational welfare of the metropolis.

Before considering the result at which the Council has arrived, it is desirable to recall that the Act of 1903 was intended to adapt the Education Act of 1902 to the particular needs of London. In detailing the methods to be followed in appointing an education committee, the earlier Act directs county councils to provide for the appointment by the council, on the nomination, where it appears desirable, of other bodies, of persons of experience in education, and of persons acquainted with the needs of the various kinds of schools in the area for which the council acts. It may be remarked that of 271 schemes approved by the Board of Education, some two-thirds provide for such co-opted members with expert knowledge. County councils are also directed to include women as well as men among members of the committee. But the number of members to constitute the committee is left to the discretion of the council.

The report now presented to the London County Council recognises the preparation of a scheme for the Education Committee as the chief duty which falls to the Council under the new Act, and the General Purposes Committee seems to have considered with due care, if not with complete understanding, schemes adopted in various local areas throughout the country, the model set them by the constitution of the London Technical Education Board, and the duties to be performed by the new Education Committee. The result of their deliberation has been strongly to "advise the Council to place two objects before it in constituting the Education Committee—(1) that the committee shall be one which will work harmoniously with the Council in developing a complete and well co-ordinated system of London education; and (2) that its constitution shall be such as to retain one of the greatest public interests under real public control as far as possible." With these objects little fault can be found, and it should have been possible to ensure both these ends and yet to have secured the assistance of co-opted members with special knowledge of the needs of every grade of education in London from the primary school to the university. Yet the report continues: "We propose that the committee shall consist of thirty-five members of the Council, with the chairman, vice-chairman and deputy-chairman, and that in accordance with the provision of the Act five women should be added, to be chosen for their experience in education. We think that the committee would be strengthened by the appointment during the term of the first committee of members of the present London School Board, and we recommend that power should be taken to add five such members. The first committee would, therefore, consist of forty-eight members." These recommendations of the committee were, after a debate consequent upon a proposed amendment, adopted, "only a few hands being held up against" them.

The scheme thus approved by the London County Council has still to be sanctioned by the Board of Education, and it may yet be hoped that an arrangement will be arrived at by which the committee—with its thirty-eight county councillors, five women and five present members of the School Board—will be strengthened by the inclusion of men fully conversant with the higher educational needs of London. The London County Council seems hardly to have been sufficiently impressed with the gigantic proportions of the task before it in co-ordinating the existing unrelated educational forces in the metropolitan area, and with the difficulties to be overcome, difficulties which can only be appreciated adequately by those familiar with London's peculiar educational requirements and deficiencies. And this is the more remarkable in view of the excellent work accomplished by its own Technical Education Board during the last decade, on which board representatives of the City and Guilds of London Institute, the London Trades Council, the trustees of the London Parochial Charities, as well as of associations of schoolmasters have acted, apparently with a due sense of their responsibility, though, during the debate upon the report, the chairman of the Technical Education Board, while testifying to the usefulness of having experts on the board, said "he always found that they did not act or vote with the same sense of responsibility as did the members of the Council on that body." His subsequent remarks, however, seemed rather to indicate that his view of responsibility meant the application of the test whether the ratepayers would approve every expenditure sanctioned by the Board. But one of the reasons for the inclusion of co-opted members with special knowledge is that there shall be a greater chance of having an educational policy

adopted which aims first to secure a good system of education and regards a small increase of the rates as a secondary consideration.

Readers of NATURE do not need to be reminded of the paramount importance of improving and completing the facilities for higher technical and for university education in London. As Sir Michael Foster said in the House of Commons, during the second reading debate on the Education Act of 1903, the new education committee and the reconstituted University of London must work together for the better education of the people of London, and the new committee must be interested in university as well as in secondary and elementary education. If, as the chairman of the General Purposes Committee remarked on proposing the adoption of the scheme outlined above, "the Education Act has any merit, it is that it co-ordinates the whole of the work of education in London." This being so, the University of London must be regarded as the necessary complement of any system of primary and secondary education in London, and the work of the University on one hand and of the schools on the other must be fashioned so that one completes what the other has appropriately prepared. To ensure this the new committee should in its deliberations be assisted by broad-minded men familiar with the work and aspirations both of the schools and of the University, and the ordinary councillor, appointed to perform a variety of administrative duties, cannot be expected to possess the necessary knowledge and experience.

The Acts to be administered clearly specify that "the local education authority shall consider the educational needs of their area and take such steps as seem to them desirable, after consultation with the Board of Education, to supply or aid the supply of education *other than elementary*, and to promote the general coordination of all forms of education," and "education other than elementary" includes not only secondary but technical and university education. It is unnecessary to point out—it has been so often done in these columns—that to aid higher education is by no means to interfere with its administration. Higher education is a matter of national importance, and is properly governed only by men with special training and varied experience. Though it would be a misfortune for any education committee to hamper the work of, say, a senate of a university by unintelligent and unnecessary dictation, it should be the aim of every such authority to encourage, assist and advance university work by every means in its power, and this can alone be effected by the presence at its meetings of expert members.

In July last we described proposals made by Lord Rosebery in a letter to the chairman of the London County Council for the establishment of a great institute of technology in London, and in a subsequent issue we recorded the fact that the Council had, in certain circumstances, agreed to provide some 20,000*l*. a year towards the maintenance of the educational work of such an institute. In view of such an arrangement as this it is surely desirable that there should be upon the new education committee some members at least fully conversant with university and higher technical education, even on such low grounds as to ensure that the Council obtains a due return for its public-spirited policy. So, if it were necessary, other instances of the practical importance of including representative persons with special qualifications upon the new committee could be given. The fact is there seems to be an ingrained dislike in this country to make use of experts. While abroad the opinions of great men of science are, even in national councils, treated with honour and respect, with us they are more or less ignored, and the example set in high places is followed by authorities of local importance only.

The London County Council is face to face with an opportunity, pregnant with possibilities, for equipping London educationally in a manner befitting the capital of a great Empire. But there is grave danger that the opportunity may be missed, and that London may continue ill-provided with facilities for the instruction of its sons and daughters in a manner to enable them properly to fulfil their destiny. So vital to our national welfare is this question of levelling up London's education that we can afford to neglect no means to ensure success; and to pass over and ignore completely the experience of those whose lives have been spent in studying educational and scientific requirements is a suicidal policy which we trust the good offices of the Board of Education will serve to avert.

SLEEPING SICKNESS.

SLEEPING SICKNESS, or African lethargy, is a disease the history of which we can trace back no further than 100 years. The first description that we know of is that of Winterbottom, who, writing of Sierra Leone in 1803, said: "The Africans are very subject to a species of lethargy which they are much afraid of, as it proves fatal in every instance." The disease has been met with along the whole of the west coast of Africa from the mouth of the Senegal to as far south as S. Paolo de Loanda. Cases have also occurred in the French Antilles, due to importation of African natives. To what extent it prevailed along the west coast of Africa in bygone days it is now impossible to say, but even at the present time many of the French possessions are perhaps as seriously affected as Uganda now is.

It exists also in the Congo basin, but probably not at all to the same extent as at present in Uganda. Regarding its distribution and its epidemic outbursts we require further information. Leaving aside these questions, it may be well to describe first the disease itself. Of its incubation period, eight to eighteen months are possible limits, but on this point also our knowledge is deficient. For convenience sake the progress of the disease is generally divided into three stages.

First stage:—The most characteristic sign that a patient has contracted the disease is a change in the facial expression. The intelligent aspect of the healthy native is replaced by a dulness, a heaviness, an expression of apathy which makes it easy to pick out the sufferer. If examined more closely the temperature may be found to be raised, and the patient may complain of headache, of indefinite pains in the body, especially over the chest.

Second stage:—The dulness of expression deepens, the gait of the patient attracts attention, it is shuffling. When spoken to the patient replies with slow, thick, mumbling speech. His tongue trembles, and a shakiness appears in the hands. The face is puffy and saliva may dribble from the mouth. The pulse is quickened, the temperature is raised. The patient sits about listlessly and is more and more disinclined for exertion. He speaks only if spoken to, then he nods and becomes drowsy again, passing gradually into the

Third stage:—All the signs are now well marked. The patient is in a state of almost complete somnolence. He lies helpless on his mat, oblivious of all around him, with filthy ulcers covering his emaciated body; thus the unfortunate being passes into a condition of complete coma—and death.

The whole course of the disease may last six months, often only two or three, and seldom twelve, and it is as

true to-day as when Winterbottom wrote 100 years ago that it proves fatal in every instance. What, then, is the cause of this fatal disease? In order to appreciate fully the recent discovery of its nature it will be necessary to recall to our mind what we know of the nature of some other well-known diseases. Those who are at all familiar with works of travel on Africa will have read of the tsetse fly and the tsetse-fly disease in cattle ngana. Travellers well know the danger to their cattle and horses of the "tsetse-fly belt," and various devices have been employed to escape the deadly bite of the fly, such as smearing the animals with dung and passing through "the belt" at night, when the flies, as a rule, do not bite, or even covering the horses with a suit of clothes.

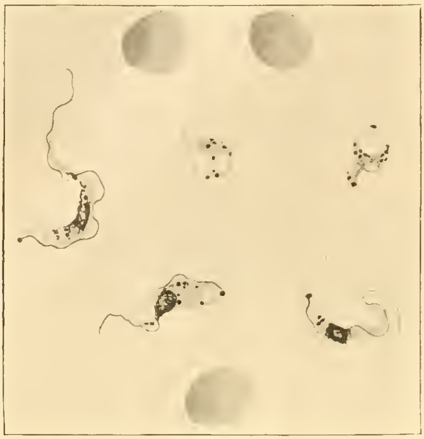


FIG. 1.

The deadly fly disease ngana was first elucidated by Col. Bruce, R.A.M.C., F.R.S., who proved that the disease was due, not to a poison injected by the fly, as Livingstone had supposed, but to a living organism, microscopic in dimensions, worm-like in aspect, moving about in the blood. This organism—a trypanosome—the tsetse fly introduces into the blood at the time of biting. It should be clearly understood, moreover, that the fly derives this trypanosome, not from water, not from decomposing matter, but solely from the blood of another animal containing these trypanosomes. The disease is, in fact, contagious just as malaria is, and in this case also the contagion (the trypanosome) is transmitted, not by contact of the healthy with unhealthy animals, but only through the agency of a fly.

"Ngana," then, is a disease in cattle caused by a trypanosome. "Surra," a somewhat similar disease well known in India, is also caused by a trypanosome, likewise mal de Caderas in South America. These are diseases affecting animals, but in 1902 Dutton, who was working in Gambia, found for the first time a trypanosome in man (a European). This, too, was the cause of a fatal disease, for the patient died in Liverpool about a year later.

Trypanosomes, then, are the cause of fatal diseases in animals, and even in man, and in one of these—ngana—the mode of infection is by the bite of a tsetse fly. Let us now turn to recent discoveries in sleeping sickness.

In November, 1902, Castellani, in Uganda, examining the cerebro-spinal fluid of a case of sleeping sickness, found a trypanosome. Bruce and Nabarro, who arrived in Uganda in March, 1903, were struck with the importance of this discovery and forthwith took up energetically an examination of the disease in this direction, with the result that they found trypanosomes in the cerebro-spinal fluid of all cases examined by them, and, moreover, they also found them in the blood. Now in all experimental work, results are frequently almost valueless unless control experiments are made. Consequently it was next established that the cerebro-spinal fluid of those not suffering from the disease did *not* contain trypanosomes. But although the blood of patients suffering from sleeping sickness contains trypanosomes, yet they are present also in the blood (in 28·7 per cent. of the population) of natives in the sleeping sickness areas, *but not outside* these areas; a very important fact and one which might well have escaped detection had not the control experiments been made. To discuss completely this fact would take us too far, and indeed our knowledge is still incomplete on this point. Suffice it to say that the existence of trypanosomes among the natives (not suffering from sleeping sickness) indicates cases of "trypanosome fever," which we have seen has been known since Dutton's discovery in Gambia and which now we know to be a common disease among natives in certain regions, *e.g.* the Congo. Bruce and Nabarro, however, believe that these cases of trypanosome fever are initial cases of sleeping sickness. So long as the trypanosome is confined to the blood we have simply "trypanosome fever," but when the trypanosome gains an entry into the cerebro-spinal fluid, then the case becomes one of sleeping sickness with the characteristic symptoms. The commissioners concluded, in fact, that sleeping sickness was due to the trypanosome.

Now as ngana, a trypanosome disease, is transmitted by a tsetse fly, the question naturally arose, could this be established for sleeping sickness? In the first place a search was made for tsetse flies; they were easily found. In the next place, by a systematic collection of biting flies of all kinds from the district, it was found that the distribution of the disease and that of a certain species of tsetse fly was practically identical. In

FIG. 2.

fact, the tsetse fly involved (*Glossina palpalis*) is, like sleeping sickness, practically confined to the shores of Victoria Nyanza and the islands. This, then, was an important confirmation of the trypanosome nature of the disease. Further, also, it was proved by experiment that the fly could transmit the trypanosome from the unhealthy (sleeping sickness patient) to the healthy (monkey), and the monkeys succumbed, with symp-

toms, so far as it is possible to judge, resembling those in man, at any rate with identical changes found in the brain after death. The problem of the nature of the disease was thus solved in a very short space of time by this brilliant piece of work.

Of the treatment of sleeping sickness there is nothing to be said. No drug or other mode of treatment has any effect; the disease is always fatal. It is possible that in prevention more hope may be put; for the tsetse flies frequent thick jungle and shun open ground. A complete study of their habits will be necessary before one can express a definite opinion; but here, as in the problem of mosquito extermination, the task will probably be no easy one.

The illustrations represent (Fig. 1) trypanosomes from a case of sleeping sickness, after Bruce; (Fig. 2) a tsetse fly (*Glossina palpalis*) × 3, after Austen.

J. W. W. Stephens.

RADIO-TELLURIUM.

According to a Press account of a recent lecture in Vienna, Prof. Marckwald illustrated in many striking and novel ways the intense activity of the body isolated by him from the Joachimsthal pitchblende and named radio-tellurium. The ionisation of the air in the immediate vicinity of the active substance is so intense that a current sufficiently strong to ring an electric bell was enabled to pass through it, the air forming part of the circuit. If a sheet of paper is interposed to screen the air from the rays of the preparation the effect ceases immediately and the bell stops ringing. Leyden jars were discharged without sparking by the substance, and other evidences of its great discharging power shown. All these effects were produced by a few hundredths of a milligram of the substance. Even the most active preparations of radio-tellurium, it is stated, are not self-luminous.

Prof. Marckwald obtained less than four milligrams of his substance from two tons of pitchblende. At first electrolytic methods were employed, but afterwards it was found that the active substance is completely deposited on a plate of bismuth or copper immersed for some days in the solution. The actual deposit consists almost entirely of ordinary tellurium, which possesses the power, so common in similar cases, of carrying down with it during the deposition the minute trace of active matter which is responsible for the radio-activity. The active constituent is separated from the tellurium by precipitating the solution with hydrazin hydrate. The tellurium precipitated is inactive, and the new body remains in the solution.

Prof. Marckwald is, however, alone in considering it to be a new substance. The radiations from it consist only of the α or non-penetrating variety, and this is the characteristic feature of polonium, discovered by Mme. Curie, who has protested against the name radio-tellurium being given to the body described by Prof. Marckwald. The activity of polonium, however, gradually decays, diminishing to half-value in about a year, whereas Prof. Marckwald states that the activity of his body is permanent. He also states, however, that the α radiation of the body is so powerful that he obtained sufficient light by the impact of the rays on a screen of phosphorescent zinc sulphide to be plainly visible to an audience of several hundred people. These two statements seem to be physically irreconcilable according to our present knowledge of the nature of the α rays, and it is to be hoped that Prof. Marckwald will give some account of the measurements by which he has concluded that the activity of radio-tellurium is permanent. Without in any way detracting from the merit of his splendid researches on the nature of the active substance, most men of science will agree with Mme. Curie in protesting against a new name being given to it in the present state of our knowledge. The practice of rechristening well-known bodies and sending them back to the country of their origin with new names and as new discoveries, which seems to be prevalent among some German organic chemists, would, if adopted in the case of the radio-active bodies, lead to the recognised number being exactly doubled.

Frederick Soddy.

NOTES.

The article on the new education authority for London, which we print elsewhere in this issue, directs attention to a matter of vital importance to the educational interests of London. The County Council has approved a scheme by which the Education Committee concerned with the whole of the work of secondary education in London is to be made up practically of county councillors, without any persons possessing expert knowledge of science, art, literature, or education upon it, selected from outside the council. This committee, if approved by the Board of Education, would differ from the educational authorities appointed by county councils in most parts of the country, and appears contrary to the intentions of the Act under which it is constituted. Doubtless expert opinion will be obtained by the council, but the danger is that a committee constituted like that proposed for London may not know when expert guidance is necessary, and can certainly not be in sympathetic touch with all the lines along which educational progress should be made. The only way by which the interests of higher education in London can be satisfactorily represented is by the appointment of persons with special knowledge upon the committee; and by neglecting this factor of success in order to avoid the sectarian difficulty which might be involved in the selection of men and women outside the council to serve upon the committee is in our opinion a serious mistake.

The gold medal of the Royal Astronomical Society has this year been awarded to Prof. G. E. Hale, director of the Yerkes Observatory, for his method of photographing the solar surface and other astronomical work. The president of the society, Prof. H. H. Turner, will deliver the address at the anniversary meeting on Friday, February 12. The American Ambassador will be present at the meeting, and receive the medal on behalf of Prof. Hale.

The sudden death of Mr. W. G. McMillan, the secretary of the Institution of Electrical Engineers, announced last week, will be widely regretted. Mr. McMillan was laid up with a chill a short time ago, which developed into an attack of pleurisy, but he seemed to be well on the way to recovery when his sudden death from heart failure took place on January 31. Mr. McMillan, after a distinguished career at King's College, was appointed to a post under the Indian Government as chemist and metallurgist to the Ordnance Factories near Calcutta. This position he held for five years, and on his return to England he was elected to the lectureship in metallurgy at Mason College, Birmingham, which position he held until 1897, when he was appointed secretary of the Institution of Electrical Engineers. Mr. McMillan has written largely on electrometallurgical subjects, his "Treatise on Electrometallurgy" and his translation of Dr. Borcher's "Electrometallurgy" being the standard English works on this branch; he recently contributed the articles on electrochemistry and electrometallurgy to the new volumes of the

"Encyclopædia Britannica." As secretary of the Institution of Electrical Engineers he not only showed a remarkable power of hard work and organisation, but endeared himself to its members by his unfailing courtesy in a way that will make them all feel his loss as that of a personal friend.

THE lecture at the Royal Institution to-morrow, February 12, will be delivered by Mr. W. N. Shaw, F.R.S., on the subject of "Some Aspects of Modern Weather Forecasting."

SATURDAY last, February 6, was the hundredth anniversary of the death of Joseph Priestley, philosopher and divine. In Leeds the event was suitably commemorated by the congregation of Mill Hill Chapel, where Priestley was minister for some six years, and also by the Priestley Club. The members of the club, to the number of fifty, dined together, and the president, Dr. T. E. Thorpe, C.B., F.R.S., afterwards gave a public address on "The Life and Work of Joseph Priestley" in the Philosophical Hall. At Warrington the same day Dr. Thorpe unveiled a memorial tablet at the house which Priestley occupied during his stay in that town.

THERE appears to be no longer any doubt as to the presence in Lake Victoria Nyanza of medusæ indistinguishable from those of Lake Tanganyika, and the fact cannot be without its effect upon the acceptance of the view put forward by Mr. J. E. S. Moore that the fauna of Lake Tanganyika differs from that of the other East African lakes in alone possessing evidences of a marine origin. On December 1, 1903, Prof. Ray Lankester exhibited at the Zoological Society some medusæ from Victoria Nyanza obtained by Mr. Hobley on August 31, 1903, and sent to London by Sir Charles Eliot. A doubt being raised by some supporters of Mr. Moore's theory as to these medusæ having really come from Lake Victoria and not from Lake Tanganyika, Sir Charles Eliot, in a letter dated Mombasa, December 20, 1903, wrote to Prof. Lankester saying that the medusæ were collected by Mr. Hobley himself in the Kavirondo Gulf, by the side of which the railway terminus is situated, and that the water was full of them. Mr. Hobley, at the request of Sir Charles Eliot, had endeavoured to study the life-history of the medusæ, but he failed to keep them alive for more than a few days. The specimens sent to London were said by Mr. R. T. Günther to be indistinguishable from the *Limnocnida tanganyicae* of Lake Tanganyika. It is interesting in this connection to note that the Victoria medusæ were discovered quite independently in the same locality (Kavirondo, in the Kisumu district), and apparently at about the same time of year. According to *Globus* (January 28, p. 84), M. Ch. Alluaud, on the day of his arrival at Lake Victoria, discovered a marine medusa similar to that of Lake Tanganyika, and communicated an account of his discovery to the Paris Geographical Society on September 19, 1903.

THE weekly weather report, dated January 30, issued by the Meteorological Council, which gives the total rainfall from January 3, shows that the amount has been above the average in all districts except the east of Scotland and north-east of England, the greatest excess being in the Channel Islands. Dealing with the calendar month and with individual stations, the excessive rainfall was very marked. At Blacksod Point, in the north-west of Ireland, the fall amounted to 7·93 inches on thirty days (3·18 inches above the average). At Dunrossness (Shetlands) rain was measured every day, but the excess was only 1·40 inches. In the north-west of England there were considerable differences, *e.g.* Holyhead had 4·37 inches, but Liverpool only 2·08 inches. In the south-east of England the excess amounted to about 0·6 inch; at Greenwich rain fell on twenty-two days, the total amount being 2·51 inches.

VERY high tides were expected in the ordinary course on the coasts of the British Isles and France last week, but owing to a combination of other circumstances there was a phenomenal intensification of the tidal wave. Early in the morning of February 2 the tide had reached a dangerously high level round the Scilly Isles, and later our western coasts, as far north as the Irish Sea, were similarly affected; also the western half of the English Channel and the coast of Brittany. On the following day there was an abnormally high tide along the eastern half of the Channel, and even as far north as Dunbar, on the Firth of Forth, there was considerable damage attributed to the same cause. Tidal rivers, like the Thames, overflowed their banks, there being, in addition to the exceptionally high tides, an immense volume of fresh water brought down from the inland districts, where on several successive days rain had fallen heavily and laid vast tracts of country under water. The great height of this spring tide is doubtless largely due to the rather deep cyclonic depression which was signalled off our south-western coasts on February 1. On the morning of February 2 its centre was close to Scilly, where the barometer had fallen below 29 inches, or an inch below the normal, a deficiency of pressure which of itself would account for a considerable increase in the height of the water. Moving slowly into the English Channel, the centre was, on the morning of February 3, situated between Torquay and Portland, and by the following morning it had passed across the south-east of England to the Yorkshire coast, where it filled up subsequently. The official weather reports indicate that the disturbance caused comparatively little wind, there being few records of so much as a moderate gale.

THE death is announced of the Baron de Ujfalvy, known for his anthropological researches and his travels in Central Asia.

REPORTS have reached us of the discovery of a human skeleton in cave-earth at Cheddar. As relics of various ages are entombed in the Mendip cavern-deposits, we hope that the evidence will be carefully scrutinised, and that it may be possible to determine the age of these human remains.

A REUTER message from Amsterdam states that a telegram from the Governor of the Dutch East Indies, dated February 4, reports an eruption of the volcano Merapi, in the district of Klaten, accompanied by a rain of red-hot stones. Twelve people were burned to death and twenty severely injured.

A SLIGHT earthquake shock was recorded at the Liverpool Observatory, Bidston, on February 1 at 3.25 a.m. On February 2 several people felt distinct shocks of earthquake in Jersey. Between 4 a.m. and 6.45 a.m. six slight shocks were experienced, and crockery and windows rattled and furniture was shaken. Prof. Milne informs us that his records do not show any traces of disturbances corresponding to the shocks at Jersey, which therefore must have been local and very small.

THE silver medal of the Bavarian Academy of Munich has been awarded to Dr. Rudel, of Nuremberg, for his work on climatology.

THE deaths are announced of Prof. A. Edmund Hess, professor of mathematics at Marburg, and of Dr. Christian Heinzerling, formerly lecturer at Darmstadt.

ACCORDING to the *Physikalische Zeitschrift*, Prof. Curie has declined the Cross of the Legion of Honour on the ground of the important part played by his wife in the discovery of radium.

ITALIAN chemists propose to commemorate the seventieth birthday of Prof. Ugo Schiff, of Florence, who has worked for forty years in Italy. Dr. Guido Bargioni, 111 Via Aretina, Florence, has been entrusted with the arrangements.

AT a meeting of the French Physical Society on January 15 the following officers were elected:—vice-president, Prof. H. Dufet; vice-secretary, Prof. Langevin; ordinary members of council (elected for three years), Madame Curie, M. Hamy, Dr. Marage, M. Perrin; non-resident members, Prof. Blaserna (Rome), M. Maurin (Rennes), Prof. Miculescu (Bucharest), Prof. Tissot (Brest). M. d'Arsonval occupies the presidential chair in succession to M. C.-M. Gariel.

THE Municipal Council of Paris has adopted a proposal of M. Bussat for the foundation of a laboratory of applied physiology. M. Bussat has himself sketched out a scheme of the work which should be undertaken in such a laboratory, relating to the alimentary value of foodstuffs, muscular work, intoxication, &c., and he suggests that the director should give publicity to the work of the laboratory by means of courses of lectures addressed to the pupils of the professional and normal schools of Paris.

REFERRING to a suggestion made by "R. F. M." in last week's NATURE (p. 318), in the course of a letter on scientific uses of the kinematograph, Mrs. D. H. Scott sends us a copy of her paper "On the Movements of the Flowers of *Sparmannia africana*, and their Demonstration by Means of the Kinematograph," published in the *Annals of Botany* of September, 1903. The paper was noticed in our issue of November 26, 1903 (vol. lxix. p. 90).

WE have received a copy—presumably a corrected printer's proof—of a pamphlet in which Mr. W. H. Parkes proposes to deal with the "Cause of Gravitation and the Mechanism of the Universe." A sufficient indication of the character of the paper is afforded by the two opening sentences, which we here reproduce:—"Anything that is moved into an egg-shaped curve or path by external force thereby becomes attractive. This, I believe, is the cause of the universal force called gravitation, and I think it should be proved by experiments which I am not in a position to carry out."

IN the course of a paper on the land and fresh-water molluscs of Mexico, published in the *Proceedings* of the Philadelphia Academy for December, 1903, Mr. H. A. Pilsbry records from that area the remarkable slug-like snail, *Metostracon mima*, first described from Michoacan in vol. iv. of the *Proceedings* of the Malacological Society of London.

WE have received a copy of a "Guide to the Horniman Museum and Library," London Road, Forest Hill, issued by the London County Council. The manner in which this little book is drawn up strikes us as being admirably suited to the purpose for which it is intended, and in general the information appears trustworthy. On p. 31 we note, however, the statement that the duck-mole alone of the monotremes has a marsupial pouch, which is obviously an error, since the structure in question attains its fullest development in the echidna, and should be described as a mammary pouch.

WE have received from Mr. W. M. Brewer a paper on the rock-slide at Frank, Alberta Territory, Canada (*Trans.* Inst. Mining Eng., Newcastle-on-Tyne, 1903). This enormous landslip or rock-slide occurred on April 29, 1903, overwhelming the coal-mining town of Frank, which was situated at the base of Turtle Mountain. Prior to the catastrophe, that mountain reached an altitude of about 3500 feet above the neighbouring Old Man or Crow's Nest river valley. Subsequently it was found that the summit had been lowered by about 1000 feet, and that from sixty to eighty million tons of rock must have been precipitated. One immense mass, estimated at fifteen thousand tons, was moved to a distance of two miles (see Fig. 1). Indeed, the débris was scattered over an area of nearly two square miles. The base of Turtle Mountain consists of Cretaceous shales and sandstones, in which a 10-foot seam of coal has been extensively worked. The mass of the mountain is formed of Carboniferous limestone. The plane of separation between the two series is a thrust-fault along which the limestone-beds are highly contorted and shattered. Above, the limestone rose in a precipitous face overlooking the town of Frank, and it presented a threatening appearance before the rock-slide took place. It seems evident that the stability of the mountain had been weakened by the mining operations at its base. For the past two or three years about 200 tons of coal per day have been worked out, so that the area was honeycombed with tunnels, while the main level is reported to have been driven for nearly 5000 feet parallel to the stratification of the rocks. Thus the towering mass of limestone, which is traversed by many joint-planes, was weakened, and a vast portion of the summit that had for ages been subject to the weathering influence of heavy snowfalls, frosts and rains, suddenly gave way and caused the disaster.

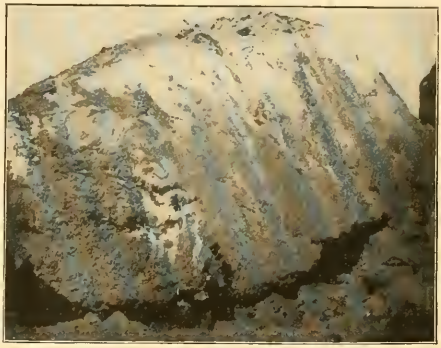


FIG. 1.—View of Boulder weighing 15,000 tons.

A THIRD edition of Mr. W. T. Lynn's "Astronomy for the Young" has been published by Messrs. Sampson Low, Marston and Co., Ltd.

MESSRS. J. AND A. CHURCHILL have published a third edition of "A Manual of Botany," vol. i., Morphology and Anatomy, by Prof. J. Reynolds Green, F.R.S.

WE have received from M. G. E. C. Gad, of Copenhagen, a copy of "Annales de l'Observatoire Magnétique de Copenhague," edited by Herr Adam Paulsen, the director of the Meteorological Institute of Denmark. The publication contains the hourly values of the magnetic elements for the years 1899 and 1900.

THE February number of the *Geographical Journal* contains several articles of exceptional importance and interest. Sir Thomas Holdich writes on the Patagonian Andes, giving a valuable summary of his recent work in connection with the Chile-Argentina Boundary Arbitration. A paper by Prince Kropotkin, of which the first part is here published, throws much new light on "The Orography of Asia." Dr. Otto Nordenskjöld and Dr. Gunnar Andersson contribute an account of the work of the Swedish Antarctic Expedition. The completed paper "On a Flat Model which Solves Problems in the Use of the Globes," by Prof. Everett, gives a number of interesting results in addition to those contained in his letter to NATURE of July 30, 1903.

WE have received a copy of a paper by Dr. P. T. Austen, reprinted from the *Scientific American* Supplement, and bearing the title "The Chemical Factor in Human Progress." The reader will find the influence of chemical knowledge upon the development of the industries, of agriculture, of sanitation, &c., discussed in a very interesting manner, and the pamphlet is well worthy of notice.

WE have received a copy of a German pamphlet by B. Kolbe the object of which is to show the manifold applicability of the differential thermoscope and a six-fold manometer in experimental demonstrations of the phenomena and laws of heat. Thirty important experiments are described which can be carried out with the aid of these instruments, and excellent illustrations of the method of demonstration are given.

THE report of the International Committee on Atomic Weights has just been issued, and only two changes are recommended from the table of values for 1903. The value for cæsium has been changed to 132·9, and that for cerium to 140·25 (O = 16). The report directs attention to the inadvisability of using glass vessels in experimental atomic weight determinations, and suggests the use of vessels of pure silica, so-called quartz-glass, in all such investigations. A redetermination of the atomic weights of gallium, indium, columbium, tantalum, mercury, tin, bismuth, antimony, palladium, vanadium, phosphorus, and silicon is regarded as necessary.

IN the December (1903) *Sitzungsberichte* of the Vienna Academy of Sciences, Prof. C. Doelter describes a form of crystallisation microscope adapted to the determination of the melting points of silicates and silicate mixtures. The attainment of high temperatures is effected by means of a small electric oven, 5 centimetres high, mounted on the object stand, and in the apparatus described a temperature of 1200° C. can be reached. The distance between the object and objective during the observation is about 27 millimetres, and by a special arrangement of asbestos plates and a spiral tube carrying ice-cold water the microscope and the objective can be kept quite cool, even when the substance under examination is subjected to a temperature of about 1200° C.

IN vol. xlv. of the *Zeitschrift fur physikalische Chemie* Dr. E. Baur describes some interesting experiments on colour-sensitive silver chloride. Mixtures of the chloride and of the subchloride Ag_2Cl prepared by treatment of colloidal silver solutions with insufficient chlorine water were mixed with about 5 per cent. of gelatin. Plates prepared with the product so obtained give the spectrum in its natural colours after one hour's exposure. The phenomenon is independent of the relative amounts of chloride and subchloride in the mixture. The author inclines to the view that several colour-sensitive forms of the subchloride exist, which are transformed into one another under the influence of the different spectral rays.

THE first number of the *British Journal of Psychology*, edited by Prof. James Ward and Dr. W. H. R. Rivers, has been published by the Cambridge University Press. The scope of the *Journal* is already known from the circular previously issued; it comprises psychology in the widest sense of the term, and is pledged to "side with no school and have no predilections"; it is not a "periodical," it has no fixed time of publication; it is rather designed to be a medium for the production of original articles and reports of experimental work. The contents of the present, presumably typical, number include an article on "The Definition of Psychology," by Prof. Ward; a sketch of Telesio's psychology, by J. Lewis McIntyre; and two important contributions on the experimental psychology of vision, by Prof. C. S. Sherrington and Prof. W. McDougall. The juxtaposition of Telesio and the experimental psychologists is itself a lecture on that progress which this *Journal* will assuredly support and stimulate.

THE additions to the Zoological Society's Gardens during the past week include a Ring-necked Parrakeet (*Palaeornis torquatus*) from India, presented by Miss M. Bull; four Hybrid Silver Pheasants (between *Euplocamus nycthemerus* and *Phasianus colchicus*), presented by Mr. H. S. Gladstone; two Black-headed Lemurs (*Lemur brunneus*) from Madagascar, presented by Mr. H. C. Jenkins; a Tayra (*Galictis barbara*) from South America, a Vulpine Phalanger (*Trichosurus vulpecula*) from Australia, a Levaillant's Amazon (*Chrysotis levaillanti*) from Mexico, a Malabar Parrakeet (*Palaeornis peristerodes*), three Hardwick's Mastigures (*Uromastix hardwicki*) from India, a Pennsylvanian Mud Terrapin (*Cinosternum pennsylvanicum*) from North America, deposited; a Racket-tailed Parrot (*Prioniturus platurus*), an Everett's Thick-billed Parrakeet (*Tanygnathus everetti*) from the Philippine Islands, two Red Lories (*Eos rubra*) from Moluccas, two Blue-streaked Lories (*Eos reticulata*) from Timor Laut, a Tabuan Parrakeet (*Pyrrhulopsis tabuan*) from the Fiji Islands, two Wonga-wonga Pigeons (*Leucosarcia picata*) from New South Wales, purchased.

OUR ASTRONOMICAL COLUMN.

REPORT OF THE HARVARD COLLEGE OBSERVATORY.—In the forty-eighth annual report of the Harvard College Observatory, Prof. E. C. Pickering, the director, again directs attention to the urgent need for cooperation in the study of the greater unsolved astronomical problems, and indicates the methods of procedure whereby the greatest results might be obtained from the least expenditure. In the solution of many of these problems the numerous photographs already obtained at Harvard would, if the funds necessary for their reduction were forthcoming, be of inestimable value.

The body of the report deals with the work accomplished during the year ending September 30, 1903, the observations made with each instrument being treated separately.

More than 15,000 photometric light comparisons have been made with the East equatorial, the computed error of each set of sixteen settings only amounting to three or four hundredths of a magnitude. Photometric measurements of the light of Jupiter's satellites, whilst undergoing eclipse, have been made during fifteen eclipses. The variability of some 2000 stars, suspected by other observers, has been definitely determined, and it is estimated that the time of minimum of Algol variables can be determined to within two minutes with this instrument.

The director has made 71,992 settings of the 12-inch meridian photometer during 143 nights, and by interposing a shaded glass has found it possible to compare magnitudes of such widely different orders as those of Sirius and a twelfth magnitude star. Another modification of this instrument permitted the light of the sky during the daytime, at twilight, and at night, the brightness of various portions

of the moon and of the sky at various distances from it, to be compared, and a range of more than seventeen magnitudes was found to exist between the extreme values obtained. During the period covered by the report Mrs. Fleming classified the spectra and measured the light of 3506 stars, situated south of declination $-60°$, for the Southern Draper Catalogue. It is hoped that this zone will be completed shortly, and a catalogue containing nearly 4000 stars, all fainter than the ninth magnitude, published.

A large number of photographs have been obtained with the 13-inch Boyden and the 8-inch Bache telescopes at Arequipa, and a number of excellent light curves of Eros (from March 30 to August 19), showing a range of 0·5 to 1·0 magnitude, were obtained with the former instrument by Prof. Bailey. Four hundred and thirteen photographs, including eighty-seven of Eros, were obtained at the same station with the Bruce photographic telescope.

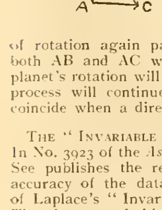
The meteorology of the upper air has been studied at the subsidiary observatory at Blue Hill, where fifteen kite flights, twelve of which were the monthly flights for the international series, were performed. The average height above sea-level attained by the meteorograph was 6450 feet, and the maximum height was 12,070 feet.

It is hoped that in a few months the Revised Harvard Photometry, containing the photometric magnitudes of all stars brighter than magnitude 6·5, about 9000 in all, together with the spectrum class of each star and its designation in other catalogues, will be published.

A set of fifty-five $8'' \times 10''$ contact prints from the original negatives, taken with the Harvard and Arequipa anastigmatic lenses, which cover the whole sky and contain all stars down to the twelfth magnitude, may be obtained by astronomers from the director for the sum of 15 dollars.

THE DIRECT AND RETROGRADE ROTATIONS OF THE PLANETS.—In a paper communicated to No. 3925 of the *Astronomische Nachrichten*, Prof. W. H. Pickering discusses the various theories which have been promulgated in explanation of the direct and retrograde rotations of the planets. Dismissing the theories of Laplace, Kirkwood, Faye and Trowbridge as insufficient, on the grounds that they presuppose abnormal conditions in the case of Neptune, and do not account for the perpendicular rotation of Uranus, he points out that the different motions may be explained by the tidal action of the sun in the following manner :—

Taking the case of Uranus as an example, let the line AB in the diagram represent the plane of the equator when this plane passes through the sun, let AC represent the plane of the planet's orbit and imagine the planet beyond the sun. Then the point A on the equator of the planet would, in the rotation, travel in the direction AB. The sun's attraction, in producing an annual tide, will produce a force AC acting on the particle A, with the consequence that A will travel along the resultant AD instead of along AB. This force AC will diminish during the planet's revolution until, after a quarter of a revolution, it will be zero. After half a revolution, when the plane of rotation again passes through the sun, the senses of both AB and AC will be reversed, but the effect on the planet's rotation will be the same as in the first case. This process will continue until ultimately the two planes will coincide when a direct rotation has been established.



THE "INVARIABLE PLANE" OF THE PLANETARY SYSTEM.—In No. 3923 of the *Astronomische Nachrichten*, Prof. T. J. J. See publishes the results of a detailed discussion of the accuracy of the data now available for the determination of Laplace's "Invariable Plane" of the planetary system. The elements of this plane are dependent upon the masses of the planets and the elements of their orbits, and the plane, when determined, would form a constant reference plane of great utility for the orbits of planets and comets. The transformations necessary to reduce star-places to this plane would be too cumbersome for practical utility.

Prof. See, in the first place, explains the mathematical process by which the elements of the plane are obtained when the planetary data are known, and then gives the results previously obtained. In the second part of his paper he reviews and discusses the values hitherto obtained for the mass of each of the planets, and deduces that for the mass of Jupiter, which, owing to its relatively large magnitude, acts as the most important factor of the reduction, the uncertainty does not amount to more than 0·0001 of the whole.

The elements obtained by Prof. See are as follows :—

$$\gamma = 1°\ 35'\ 7''\!\cdot\!74,\quad 5\,\Omega = 106°\ 8'\ 46''\!\cdot\!688 \left\}\begin{array}{l}\text{Ecliptic and mean}\\ \text{equinox 1850}\\ \text{Jan. 0·0 G.M.T.}\end{array}\right.$$

where γ = the inclination of the plane, and Ω = the longitude of its ascending node on the fixed ecliptic of 1850·0.

In a subsequent table the author gives the longitudes of the ascending nodes and the inclinations of the planetary orbits on this "Invariable Plane," and, from a computation based on the relative positions of the planets at the epoch of 1850·0, he concludes that the actual shifting of the plane due to improvement in the data of the masses is not likely to exceed $1''$ for γ and $1'$ for Ω, a degree of accuracy approximating to that of our knowledge of the ecliptic and equator. He considers that a value for the inclination of which the probable error did not exceed $\pm 0''\!\cdot\!20$ would suffice for all practical considerations, and points out the importance of further work on the determination of the planetary masses, which only need to be a little more certain in order to produce this ideal result.

SIMULTANEOUS SOLAR AND TERRESTRIAL CHANGES.[1]

THERE are very many cases recorded in the history of science in which we find that the most valuable and important applications have arisen from the study of the ideally useless. Long period weather forecasting, which at last seems to be coming into the region of practical politics as a result of the observation of solar changes, is another example of this sequence.

The first indications of these changes on the sun, to which I have referred, are matters of very ancient history, and so also is the origin of some of the branches of observation on which the study of them depends.

I will begin by referring to these and to the conclusions arrived at in relation to simultaneous solar and terrestrial changes previously to the last twenty-five years.

The facts that there are sometimes spots on the sun, and that there is a magnetic force which acts upon a needle, seem to have been known to the ancient Chinese. In more modern times the inquiries, with which we are now concerned, date from the times of Galileo (1564–1642) and Kepler (1571–1630).

To Galileo, Fabricius, and Scheiner we owe the first telescopic observations of the spots on the sun; to Kepler, the basis of spectrum analysis, which has not only revealed to us the chemistry of the sun and of its spots, but enables us to study daily other phenomena, the solar prominences, which will in all probability turn out to be more important for practical purposes than the spots themselves.

It is only quite recently that the importance of the study of the prominences in this direction has been indicated, so that we have to deal, in the first instance, with a long period of years in which only the spots and their terrestrial echoes were in question.

According to Prof. Wolf (as quoted by Prof. Köppen), Riccioli, in 1651, shortly after the first discovery of sunspots, surmised that some coincidence might exist between them and terrestrial weather changes (Blanford, Bengal, Asiat. Soc. *Journ.*, lxv., part ii., 1875, p. 22).

In the first year of the last century, Sir Wm. Herschel directed attention to this subject (*Phil. Trans.*, 1801, p. 265). He wrote :—

"The first thing which appears from astronomical observations of the sun is that the periods of the disappearance of spots on the sun are of much greater duration than those of their appearance.

[1] Paper presented to the International Meteorological Committee at Southport, September 11, 1903. By Sir J. Norman Lockyer, K.C.B., F.R.S.

"With regard to the contemporary severity and mildness of the seasons, it will hardly be necessary to remark that nothing decisive can be obtained. An indirect source of information, however, is opened to us by applying to the influence of sunbeams on the vegetation of wheat in this country. I do not mean to say that this is a real criterion of the quantity of light and heat emitted by the sun, much less will the price of this article completely represent the scarcity or abundance of the absolute produce of the country.

"On reviewing the period 1650–1713, it seems probable, from the prevailing price of wheat, that some temporary scarcity or defect of vegetation has generally taken place when the sun has been *without* those appearances which we surmise to be symptoms of a copious emission of light and heat.

"To those acquainted with agriculture who may remark that wheat is well-known to grow in climates much colder than ours, and that a proper distribution of rain and dry weather are probably of much greater consequence than the absolute quantity of light and heat derived from the sun, I shall only suggest that those very circumstances of proper alternations of rain and dry weather and wind, &c., favourable to vegetation, may possibly depend on a certain quantity of sunbeams being supplied to them."

Herschel's suggestion was a daring one, for however perfect our national statistics may have been in relation to the price of wheat, there was nowhere kept up a continuous record of the changes observable on the sun's surface, nor had there been any serious attempt made to determine the law underlying them.

In 1825 this serious attempt was made, and by Schwabe, of Dessau, who discovered a cycle of about eleven years in the solar changes. Wolf afterwards took up the question.

Herschel had associated the variation in the number of spots with that in the price of corn, the connecting link being sunshine or weather. It was to him a question of meteorology.

A year after the publication of Herschel's papers, Wollaston extended the early spectrum work of Kepler and Newton by discovering that in the solar spectrum there were many dark lines; these were for the first time mapped by Fraunhofer in 1814.

Soon after 1850 it became a question of the connection of sun-spots with terrestrial magnetism as well as with meteorology. A new idea was introduced.

Lamont, Sabine, and Allan Broun discovered that there was a well marked coincidence between the variations of magnetic effects, as observed on the surface of our planet by delicately suspended magnets, and the quantity of spotted area observed on the sun. This in later telegraphic days is not merely a pious opinion which does not interest anybody, because, when the magnetic changes are very considerable and the disturbances arrive at a maximum, it is very difficult to get a telegram from London to Brighton.

The period around the year 1860 was rendered ever memorable by a still further extension of Kepler's and Newton's work, which at once explained the dark lines observed in the solar spectrum by Wollaston and Fraunhofer.

Hitherto undreamt-of attacks on the nature of the sun became possible. The names of Kirchhoff, Bunsen, Ångström, Stokes, Balfour Stewart will go for very long down the stream of time, because they showed us that in spectrum analysis we had the power of practically conversing, chemically, with the distant worlds in space, and these distant worlds, of course, included the sun, although it is practically our neighbour.

It was now established that the solar radiation came from the incandescence of metallic vapours and gases in the sun's atmosphere, the metals and gases being for the most part those with which we are familiar on the earth. Not only was a high temperature demonstrated in this way, but it was further shown that above the sun's apparent surface there was an absorbing atmosphere, consisting of vapours cooler than those below, but yet hot enough to be composed of the steam of iron and other metals.

In 1865, De la Rue, Stewart, and others, in an attempt to get the periodicity of the solar phenomena still more accurately determined, started work at Kew; while the former observations were carried on by Schwabe and Wolf by the eye, photography, which was then being introduced into astronomical work by the labours of Warren De la Rue, was for the first time now utilised, and a picture of the sun was taken each day.

In 1866 a new method of observing solar changes, which consisted in throwing an image of the sun on the slit plate of a spectroscope, revealed the fact that the spectra of spots differed from that of the photosphere generally; certain lines were widened in the spot spectrum (Lockyer, *Proc.* Roy. Soc., October 11, 1866).

In 1867 a connection between changes in spotted area and in terrestrial temperatures was pointed out by Baxendell (*Memoirs* of the Manchester Lit. and Phil. Soc., third series, vol. iv., pp. 128 *et seq.*). He noticed a distinct and very striking relation between the number of sun-spots and the ratio which exists between the difference of the mean maximum temperature of solar radiation and the mean maximum air temperature on the one hand, and that of the mean temperature of the air and of evaporation on the other.

In 1868 a spectroscopic method was discovered of observing in full daylight the "prominences" or "red flames" which hitherto had only been glimpsed during eclipses, and it was established that, closely surrounding the sun ordinarily seen, there was an envelope, named the chromosphere, of incandescent gases and vapours, hydrogen, and a new substance named helium chief among them (Lockyer, *Proc.* Roy. Soc., October 20, 1868).

Many spectroscopic observations made on the spots and prominences about this time indicated great changes in the solar temperature in different regions, and possibly, therefore, changes in the amount of heat radiated earthwards. From the changes thus actually seen it was easy to imagine that there might be a cycle of terrestrial changes depending no longer on the sun's presentation to us in its daily and yearly rounds, but on physical changes in the sun itself, requiring, perhaps, many years to accomplish.

In 1869 Janssen showed (*Comptes rendus*, vol. lxviii. (1869), pp. 367 *et seq.*) that by a special arrangement of the spectroscope an image of the sun, showing the prominences both on the disc and surrounding it, might be obtained.

It was not very long before it was found that the reaction of these solar changes on the earth was not so limited as had formerly been thought. This was an idea started by Dr. Stone, of the Royal Observatory at the Cape of Good Hope, Piazzi Smyth, of the Royal Observatory of Edinburgh, and others, about the years 1870 and 1871, but the most striking Imperial contribution to the matter we owe to the labours of a distinguished meteorologist, Dr. Meldrum, director of the observatory at Mauritius, which has since become the Royal Alfred Observatory. He showed that the number of wrecks which came into the harbour of the Mauritius and the number of cyclones observed in the Indian Ocean could enable anyone to determine the number of spots that were on the sun about the time. The Mauritius is most admirably suited for the making of these observations, because the tropics are really the right region in which to try and estimate the possibilities of this solar action. Meldrum found, in fact, that the maximum number of cyclones was associated with the maximum number of sun-spots. He wrote (NATURE, vol. vi. p. 357, 1872):—

"During the period 1847–72 it is found that some years have been remarkable for a frequency, and others for a comparative absence of cyclones.

"1847–51	were characterised by	cyclone frequency.
"1852–57	,, ,,	,, comparative calm.
"1858–63	,, ,,	,, cyclone frequency.
"1864–68	,, ,,	,, decrease.
"1868–72	,, ,,	,, great increase.

"It will be seen that the years correspond with the maxima and minima epochs of sun-spots. It appears to me that there is more than a mere coincidence as to time.

"The numbers of wrecks during these periods also show a similarly regulated frequency."

Poey, investigating shortly afterwards the cyclone condition in the West Indies (*Comptes rendus*, November 24, 1873, p. 1222), found that the greater number of years of maxima of storms fall from six months to two years, at the most, after the years of maxima of solar spots.

Out of twelve maxima of storms, ten coincide with maxima periods of spots. Out of five minima of storms, five coincide with minima of spots.

It will be seen that the results from both the East and West Indies are the same. Next came the question of a rainfall cycle corresponding to the solar spots ("Solar Physics," Lockyer, 1874, p. 425).

When I was preparing to go to India, in 1871, to observe the eclipse, Mr. Ferguson, the editor of the *Ceylon Observer*, who happened to be in London, informed me that everybody in Ceylon recognised a cycle of about thirteen years or so in the intensity of the monsoon—that the rainfall and cloudy weather were more intense every thirteen years or so. This, of course, set one interested in solar matters thinking, and I said to him:—"But are you sure the cycle recurs every thirteen years, are you sure it is not every eleven years?" adding, as my reason, that the sun-spot period was one of eleven years or thereabouts, and that in the regular weather of the tropics, if anywhere, this should come out.

It afterwards turned out that the period in Ceylon was really of eleven years, five or six years dry and five or six years wet, and that a longer period of about thirty-three years was recognised.

Mr. Meldrum passed from cyclones to rainfall by a very obvious step, because cyclones are generally accompanied by torrential rains. A study of the rainfalls of Port Louis, Brisbane, and Adelaide led him to the conclusion that a case had been made out for a supposed periodicity.

On my return from India I looked up the Cape and Madras records for the periods available, and found that they followed suit, hence I quite agreed with Dr. Meldrum that investigations were desirable, and I wrote as follows ("Solar Physics," pp. 424–5):—

"Surely in meteorology, as in astronomy, the thing to hunt down is a cycle, and if that is not to be found in the temperate zone, then go to frigid zones, or the torrid zones and look for it, and if found, then above all things, and in whatever manner, lay hold of, study it, record it, and see what it means. If there is no cycle, then despair for a time if you will, but yet plant firmly your science on a physical basis, as Dr. Balfour Stewart long ago suggested, before, to the infinite detriment of English science, he left the Meteorological Observatory at Kew; and having got such a basis as this, wait for results. In the absence of these methods, statements of what is happening to a blackened bulb in vacuo, or its companion exposed to the sky, is, for research purposes, work of the tenth order of importance."

With reference chiefly to Dr. Meldrum's paper, I added:—

"Surely here is evidence enough, evidence which should no longer allow us to deceive ourselves as to the present state of meteorology. A most important cycle has been discovered, analogous in most respects to the Saros discovered by the astronomers of old, indeed, in more respects than one, may the eleven yearly period be called the Saros of meteorology, and as the astronomers of old were profoundly ignorant of the true cause of the Saros period, so the meteorologists of the present day are profoundly ignorant of the true nature of the connection between the sun and the earth.

"What, therefore, is necessary in order to discover the true nature of this nexus? Two things are necessary, and they are these. In the first place, we must obtain an accurate knowledge of the currents of the sun, and secondly, we must obtain an accurate knowledge of the currents of the earth. The former of these demands the united efforts of photography and spectrum analysis, and the second of these demands the pursuit of meteorology as a physical science, and not as a mere collection of weather statistics. When these demands are met—and in spite of the Mrs. Partingtons who are endeavouring to prevent this, they will soon be met—we shall have a science of meteorology placed on a firm basis—the meteorology of the future."[1]

At this time the Indian authorities were quite alive to the importance of such investigations as these. India is in the tropics, India is a child of the sun, the inhabitants depend almost entirely upon the beneficent rains which seemed, in some way or another, to depend upon solar action. India also had then the germs of one of the best equipped meteorological organisations which exist on the surface of the planet, and the meteorologists felt that there was something behind their meteorological registers which might be assisted by taking a very official step and going to headquarters, headquarters being the sun. When I was in India in 1872, Lord Mayo, the then Viceroy, did me the honour to ask me to go to Simla with the view of choosing a site for a proposed solar physics observatory. That is thirty years ago! Unfortunately, I was secretary of the Duke of Devonshire's Commission, which was then sitting, and I could not get leave, and therefore could not go; the scheme, which was then before the Indian authorities—which, if I may say so, was altogether grandiose and extravagant—fell through.

In 1873 the idea of the possible connection of solar and magnetic changes had got so far that the magnetic and meteorological department of the Royal Observatory at Greenwich, which had been established in 1838, received an important addition. A photoheliograph was set up in order to continue the daily photographic record of the sun's surface, begun at Kew in 1865.

In the same year Köppen found that the maximum temperature occurs in the years of sun-spot minima and the reverse; years with many spots are cool years.[1]

Of special importance for the connection between the temperature on the earth's surface with the sun's spotted area is the fact that the temperature curve (mean number for the whole earth) and the curve representing the sun-spotted area are identical in all the irregularities.

In the tropics in the

Year before the sun-spot *Min.*, the temperature is 0·41° higher than the mean.

Year before the sun-spot *Max.*, the temperature is 0·32° lower than the mean.

The variation is thus 0·73°.

By this time spectroscopic observations of the solar changes had proved that the sun was hottest when there were most spots, thereby upsetting the old idea that the spots acted as screens and reduced the radiation at sun-spot maximum. Köppen's result, therefore, was a paradox, and was thus explained by Blanford (Bengal, Asiat. Soc. *Journ.*, 1875):—

"The temperatures dealt with by Prof. Köppen are of course those of the lowest stratum of the atmosphere at land stations, and must be determined *not by the quantity of heat that falls on the exterior of the planet, but on that which penetrates to the earth's surface, chiefly to the land surface of the globe.* The greater part of the earth's surface being, however, one of water, the principal immediate effect of the increased heat must be the increase of evaporation, and, therefore, as a subsequent process, the cloud and the rainfall. Now a cloudy atmosphere intercepts the greater part of the solar heat, and the re-evaporation of the fallen rain lowers the temperature of the surface from which it evaporates and that of the stratum of air in contact with it. The heat liberated by cloud condensation doubtless raises the temperature of the air at the altitude of the cloudy stratum; but at the same time we have two causes at work, equally tending to depress that of the lowest stratum. As a consequence, an increased formation of vapour, and therefore of rain, following on an increase of radiation, might be expected to coincide with a low air-temperature on the surface of the land" (see also Blanford, NATURE, April 23, 1891, vol. xliii. p. 583).

The next important advance had to do with atmospheric pressure. In 1875 Mr. F. Chambers, the director of the Bombay Observatory, found that

"The variation of the yearly mean barometric pressure at Bombay shows a periodicity nearly corresponding in duration with the decennial sun-spot period" (Meteorology, Bombay Presidency, August, 1875, S. 26, p. 12).

The years round 1875 were rendered very important by the number of new organisations established to record and

[1] I very much regret that, in the article quoted, my reference to Carlyle's German "Dry as dust," as a patient inquirer who would eventually apportion credit to all meteorological workers, has been misunderstood by some of my German friends. Relying on imperfect dictionaries, which have told them that a mere "bookworm" was meant, they have missed the high compliment I intended to pay them.

[1] W. Köppen, "Über mehrjährige Perioden der Witterung" (*Zeitschrift. f. Meteorologie*, Bd. viii., 1873, pp. 241–248 and 257–268).

demonstrate various classes of observations with which we are concerned in this short history. Meteorological inquiries on a large scale were organised at home and in India, and observatories were established at Potsdam, Paris, and London, with the main object of studying solar changes. At the same time steps were taken to resume observations in the tropics. It is not out of place here to make a brief reference to what was done in Britain and in India.

The Government took this action in consequence of a strong recommendation of the Royal Commission on Science, presided over by the late Duke of Devonshire, for the establishment by the State of an observatory of solar physics in which inquiries relating to the nature of the sun and its changes should be fostered, and various investigations which were necessary should be carried on.

The commission also proposed that similar institutions should be established in various parts of the Empire.

The ground on which the Royal Commission, and subsequently a memorial presented to the Government by the British Association, urged this new departure was that, in the opinion of a considerable number of scientific men, there was a more or less intimate connection between the state of the sun's surface and the meteorology of the earth, and they directed attention to the fact that recent independent investigations on the part of several persons had led them to the conclusion that there was a similarity between the sun-spot period, periods of famine in India, and cyclones in the Indian Ocean. The memorialists concluded by saying:—

"We remind your Lordships that this important and practical scientific question cannot be set definitely at rest without the aid of some such institution as that the establishment of which we now urge."

The Lords of the Committee of Council on Education referred this memorial to a committee, consisting of Prof. Stokes, Prof. Balfour Stewart, and General Strachey, for their opinion as to whether a commencement might not be made to give effect to the proposals of the memorialists by utilising the chemical and physical laboratories at South Kensington, as the proposed observatory must be more chemical and physical than astronomical. The following paragraph appeared in the terms of reference:—

"Although we are not at present in a position to consider the establishment of a physical observatory on a comprehensive scale, we believe that some advantage can be gained if a new class of observations can be made with the means at command, since the best method of conducting a physical laboratory may thus be worked out experimentally, and an outlay eventually avoided which, without such experience, might have been considered necessary."

While the discussion as to the establishment of a solar physics observatory in this country was going on, Lord Salisbury, who was then Secretary of State for India, permitted me to send him a memorandum on this subject. In it I pointed out that what we wanted, especially in reference to solar inquiries, was to learn, day by day, what the sun was really doing, which India and other tropical countries always could tell us, while it seemed almost impossible that we should ever get sufficiently continuous records in England.

I gave the following extracts:—

"Solar research is now being specially carried on in Europe at—

"(1) Potsdam, in the new Sonnenwarte.

"(2) Paris, in the new physical observatory.

"(3) Rome and Palermo.

"(4) South Kensington, in connection with the Science and Art Department.

"(5) At Greenwich, Wilna, and other places it is carried on in a less special way.

"In these European observatories, however, especially in the more northern ones, we are attempting to make bricks without straw, that is, the climate is such that the observations are often interrupted, at times for weeks together, while, in addition to this, in winter the sun's altitude is so small that fine work is impossible.

"While this state of things holds in Europe, in India, on the other hand, one has an unlimited and constant supply of the *raw material*, by which I mean that here one can, if one chooses, obtain observations of the finest quality in sufficient quantity all the year round. I may even go further, and say that, limiting my remark to English ground, we have in India a *monopoly* of the raw material."

The prayer of the memorandum was granted, and shortly afterwards I had the pleasure of sending out one of my assistants to India. Unfortunately, he died soon after the first series of daily photographs of the sun had been commenced, but eventually the Trigonometrical Survey Department took the matter up, an observatory was built at Dehra Dun, and India began its work, and I am thankful to say that it has gone on continuously ever since.

It was not until 1879, and after a letter from the Duke of Devonshire, that a sum of 500*l.* was taken on the estimates to replace the assistance formerly obtained by myself from the Government Grant Fund administered by the Royal Society, and to allow of more research work being undertaken. At the same time the Solar Physics Committee was appointed. The object sought was to make trial of methods of observation, to collect and discuss results, to bring together all existing information on the subject, and to endeavour to obtain complete series of observations along the most important lines.

This State action was taken because the sun has to be studied, if studied at all, continuously, because it is ever changing, and the more we study it the longer are the cycles which we find to be involved; hence, all inquiries into its nature must be on an Imperial basis. Individuals die, nations remain. Nor is this all. Observatories are not only wanted in the centres of intellectual activity where research can be conducted in a scientific atmosphere, but there must be others to obtain the necessary observations in those favoured regions of our planet in which the maximum of sunshine can be depended upon.

The then Astronomer Royal, Sir George Airy, was most sympathetic, and as a result of this State action the little observatory at South Kensington was shortly afterwards enlarged; it has considerably grown since then, but it is still in the experimental stage. Although, perhaps, I am not the one to say it, I am prepared to take the responsibility of stating that it is now one of the best equipped for its special work in the world. It certainly is the shabbiest to look at. Irreverent comparisons have been made even in the House of Commons, the general appearance of its wood and canvas huts having been likened to that of a more or less disreputable looking travelling menagerie, but, at all events, it is instrumentally efficient, and that for the present must be sufficient.

During the last quarter of a century a great deal of work has been going on, and the colonies and dependencies of Britain have also been doing yeoman service; very little has been said about it, because not all departments are in the habit of advertising themselves, and Blue Books are not as a rule light reading. In the first place, the Indian daily photographic record, which was weak during a month or two during the south-west monsoon, was supplemented by the erection of a duplicate instrument at the Mauritius, and I am again thankful to say that the work has gone on at the Mauritius continuously since. Thus we have now two tropical records, which, taken together, may be described as absolutely continuous, of solar changes sent to us in the most Imperial fashion by two observatories. Another appeal was made to Australia. For a time records were sent us, but I am sorry to say that after a time they ceased.

These records are sent regularly with every precaution against loss to the observatory at South Kensington, and for the days when no photographs have been taken at Greenwich the necessary photographs are transmitted there, where they are reduced in continuation of the record commenced in 1873 there, in succession to Kew.

What has been the result of this? The late Astronomer Royal took up this work at Greenwich in 1873. In 1874, 1875, 1876, 1877, 1878, the average number of days on which it was possible to obtain photographs in each year was a little more than 160, the exact figures being 159, 161, 167, 171, 149. This was Greenwich working alone, national work.

Next, we come to the Imperial work. Selecting years at random, and dealing with 1889 to 1893, I find that we obtained photographs of the sun in 1889 for every day in the year except five, in 1890 for every day except four, in 1891

for every day except two. It is easy to understand that with such a magnificently complete record as this the study of solar physics was enormously improved.

Very fortunately for science, even before these steps were being taken to secure a continuous record of the spotted area, Prof. Respighi (1869) and Prof. Tacchini (1872) had commenced at Rome a daily record of the solar prominences and of the latitudes at which they appeared at different times.

I pass on to some of the most important work done during the last quarter of a century, only referring to the results obtained which bear upon the connection between solar and terrestrial changes.

Many important advances were made in 1878.

Mr. F. Chambers, in continuing his studies on the Indian barometer, found (Nature, vol. xviii. p. 567) a remarkable degree of resemblance in the progression of barometric pressure during summer, winter, and year, and sun-spots from year to year, but he noted that the barometric curve *lags* behind the sun-spot curve, particularly in the years of maxima of sun-spots. The winter curve is more regular than the summer one, probably because the weather generally in India is more settled in the winter than in the summer, but on the whole the two curves support each other in having a *low pressure* about the time of *sun-spot maximum*, and a high pressure about the time of sun-spot minimum. We may therefore conclude that the *sun is hottest* about the time when the *spots are at a maximum*. He added that these results appear to harmonise well with the decennial variations of the rainfall in India, and to throw light upon the inverse variation (compared with the sun-spots) of the winter rainfall of northern India.

Dr. Allan Broun also, in a discussion of Indian barometric readings, found that the years of greatest and least pressure are probably the same for all India, and that, therefore, the relation established by Mr. Chambers for Bombay holds for all India (Nature, vol. xix. p. 6).

I next pass to rainfall. Dr. Meldrum, returning to his rainfall studies, found that (Nature, vol. xviii. p. 565)

"There is a remarkable coincidence between the rainfall and sun-spot variation at Edinburgh, much more remarkable than that at Madras. The years of maximum and minimum rainfall, and sun-spots for the mean cycles, coincide, and on the whole there is a regular gradation from minimum to maximum, and from maximum to the next minimum."

The minimum rainfall occurred, on an average, in the year immediately preceding the year of maximum sun-spots.

The results of these investigations show that the rainfall of fifty-four stations in Great Britain from 1824–1867 was 0·75 inches *below mean* when sun-spots were at a minimum, and 0·90 inches *above mean* when sun-spots were at a maximum.

For the thirty-four stations in America, the corresponding numbers were 0·94 inch and 1·13 inch.

In the report of the Meteorological Department of the Government of India, published this year (1878), the following reference to solar action occurs:—

"The following are the main important inferences that the meteorology of India in the years 1877–1878 appears to suggest, if not to establish:—

"There is a tendency at the minimum sun-spot periods to prolonged excessive pressure over India, and to an unusual development of the winter rains, and to the occurrence of abnormally heavy snowfall over the Himalayan region. . . . This appears also to be accompanied by a weak south-west monsoon."

In 1880 the relation of Indian famines and the barometer was first fully treated by Mr. F. Chambers, the meteorological reporter for western India (Nature, vol. xxiii. p. 109). He concluded from his inquiry that there is some intimate relation between the variations of *sun-spots*, *barometric pressure*, and *rainfall*, and as famines in general are induced by a deficiency of rain, it is probable that they also may be added to the above list of connected phenomena.

Commencing with the daily abnormal variations observed at several stations in western India, it was found that as the time over which an abnormal barometric fluctuation extended became longer and longer, the range of the fluctuation became more and more uniform at the various stations, thus leading to the conclusion that the "*abnormal variations of long duration affect a very wide area.*" For testing this, the conditions of Batavia were compared with those at Bombay, and the results showed a striking coincidence, the curves obtained for the two places being almost identical in form, but with this remarkable difference, the curve for Batavia was found *to lag* very persistently about one month *behind* the Bombay curve.

Similar results were then worked out for other stations, St. Helena, Mauritius, Madras, Calcutta, and Zi-ka-wei. On comparing the curves obtained for these various places, though a strong resemblance in form between all the curves is observed, there is also strong evidence of a want of simultaneity in the barometric movements at different stations, and as a rule the changes take place at the *more westerly stations* several months *earlier than* at the more *easterly ones*.

Thus on comparing the curves for St. Helena and Madras from 1841–1846, the latter sometimes lagged behind the former as much as six months, and for Bombay and Calcutta the corresponding difference was often upwards of six months.

The facts suggested to him long atmospheric waves (if such they may be called) travelling at a very slow and variable rate round the earth, from *west to east*, like the cyclones of the extra-tropical latitudes.

With special reference to famines, he remarked that, on comparing the dates of all the severe famines which have occurred in India since 1841, widespread and severe famines are generally accompanied or immediately preceded by waves of high barometric pressure. He suggested, therefore, that intimation of the approach of famines might be obtained in two ways:—

(*a*) By regular observations of the solar spotted area and early reductions of the observations, so as to obtain early information of current changes going on in the sun.

(*b*) By barometric observations at stations differing widely in longitude, and the early communications of the results to stations situated to the eastward.

In the same year, Dr. H. F. Blanford discovered that (Nature, vol. xxi. p. 480)

"Between Russia and Western Siberia on the one hand, and the Indo-Malayan region on the other, there is a reciprocating and cyclical oscillation of barometric pressure, of such a character that the pressure is at a maximum in *Western Siberia* and *Russia* about the epoch of maximum sun-spots, and in the *Indo-Malayan area* at that of minimum sun-spots."

Up to 1881, the general idea had been that there was a great difference between the meteorological conditions at the maximum and minimum of the sun-spot curve, but the more numerous and more accurate series of observations available in the year in question revealed to Meldrum "extreme oscillations of weather changes in different places at the turning points of the curves representing the increase and decrease of solar activity."

This was a most important change of front. Not the maximum only, but both the maximum and minimum had to be considered ("Relations of Weather and Mortality, and in the Climatic Effect of Forests").

In relation to these pressure changes Blanford wrote as follows (Nature, vol. xxi. p. 482):—

"Among the best established variations in terrestrial meteorology which conform to the sun-spot cycle, are those of tropical cyclones, and the general rainfall of the globe, both of which imply a corresponding variation in evaporation and the condensation of vapour. Now the variation of pressure with which we have to deal evidently has its seat in the higher (probably the cloud-forming) strata of the atmosphere. This is not only illustrated in the present instance by the observed relative excess of pressure at the hill stations as compared with the plains, but also follows as a general law from the fact established by Gautier and Köppen, viz., that the temperature of the lowest stratum varies in a manner antagonistic to the observed variation of pressure. It is then a reasonable inference that the principal agency in producing the observed reduction of pressure at the epoch of sun-spot maximum is the more copious production and ascent of vapour, which may operate

in three different ways. First, by displacing air the density of which is three-eighths greater; second, by evolving latent heat in its condensation; and thirdly, by causing ascending currents, and thus reducing dynamically the pressure of the atmosphere as a whole. The first and second of these processes do not indeed directly reduce the pressure but only the density of the air stratum while they increase its volume. In order, therefore, that the observed effect may follow, a portion of the higher atmosphere must be removed, and this will necessarily flow away to regions where the production of vapour is at a minimum, viz., the polar and cooler portions of the temperature zones, and more especially those where a cold dry land surface radiates rapidly under a winter sky. Such an expanse is the great northern plain of European Russia and Western Siberia north of the Altai."

In 1886 we got the first fruits of the observations of the widened lines in sun-spots, which had been obtained on a definite plan, since 1879. The changes which occurred from a spot-minimum to a spot-maximum, and some distance beyond, had therefore been recorded. The changes were most marked, showing a great change in the chemistry of the spots at these times. At minimum the lines chiefly widened were those of iron and some other metals, but at the maximum the lines widened were classed as "unknown," because they had not been recorded in the spectra of the terrestrial elements. It was reasonable to suppose, therefore, that the sun was not only hotter at maximum, but hot enough to dissociate iron vapours (*Proc.* Roy. Soc., 1886, p. 353).

In 1891 Janssen's suggestion of 1869 was brought into a practical shape for observatory work by Hale and Deslandres (*Comptes rendus*, August 17, 1891), and the prominences on the sun's disc and surrounding it were photographed in full daylight by using only the light radiated by the calcium vapour, which they always contain.

By the year 1900 we had accumulated at South Kensington observations of the widened lines for a period of more than twenty years. There was a curious break in the regularity of the results obtained after 1894, and the Indian meteorologists reported contemporaneous irregularities in the Indian rainfall.

I determined, therefore, to make a connected inquiry into both these classes of phenomena. Thanks to the establishment of the Indian Meteorological Department in 1875, we had rainfall tables extending over a quarter of a century, and in the tropics, where the problems might be taken as of the simplest, to compare with the new solar data.

I have already stated that in the preliminary discussion of the most widened lines observed in the sun-spots up to the year 1885 a most remarkable difference was observed in the lines observed at sun-spot maximum and minimum. This continued until about 1895, another ten years. As the curve of iron lines went up, the curve of "unknown" lines came down; there were therefore *crossings* of the curves which might, on the hypothesis before referred to, be taken as the times at which the temperature of the sun had a mean value. These crossings turned out to be about half-way between the maxima and minima of the spotted area which had to be considered as the times at which the sun was hotter and colder than the mean.

We were then brought into the presence of three well-marked stages of solar temperature—it was no longer a question merely of spots and no spots, but of heat pulses.

The next point was to study these heat pulses in relation to the Indian rainfall, and it was found that in many parts of India the plus and minus heat pulses on the sun, which, of course, occurred immediately after the time of mean temperature, when the sun was getting either hotter or colder, were accompanied by pulses of rain in the Indian Ocean and the surrounding land. It was next found, from a study of the Indian Famine Committee's reports, that the famines which have devastated India during the last half century have occurred in the intervals between the pulses.

In 1902, with the view of getting more light on the important issues raised by the comparison of the solar heat pulses and the Indian rainfall, I determined to reduce the observations of prominences made by Tacchini at the Observatory of the Collegio Romano since 1874, and to compare the Indian meteorological conditions with them. The reason for this step was that the admirable photographs of the prominences on the solar disc, published by Hale and Deslandres, showed the extensive area over which they were distributed. An argument which has been used against the possible connection between solar and terrestrial changes was based upon the small area covered by spots. In 1877 Eliot wrote as follows (Report on the Meteorology of India, 1877, p. 2):—

"So far as can be judged from the magnitude of the sun-spots, the cyclical variation of the magnitude of the sun's face free from spots is very small compared with the surface itself; and consequently, according to mathematical principle, the effect on the elements of meteorological observations for the whole earth ought to be small."

Now the photographs to which I have referred exhibited broad bands of prominences extending almost across the whole disc, and if we assume two belts of prominences, north and south, 10° wide, with their centres over latitude 16°, a sixth of the sun's hemisphere would be in a state of disturbance. Hence it followed that the prominence effect, when fully studied, might be much more striking and important than that produced by spots.

The prior work in connection with the Indian rainfall had shown not only that there was a close connection between pressure and rainfall, but that the pressure was much the more constant element over the different areas. The comparison with the prominences obtained from the discussion of Tacchini's results was in the first instance compared with the Indian pressure curve.

The result was magnificent. In addition to the well-marked prominence maximum at the maximum of the spotted area, there were others corresponding approximately with the "crossings" of the widened lines, and all were re-echoed by the Indian barometers!

The sun-spot cycle of eleven years gave way to a prominence cycle of about 3·7 years, and by this interval, as a rule, are the Indian pressures separated.

To see whether such a striking and important result as this was limited to Indian ground, the important series of pressure observations obtained at Cordoba in South America were studied. Here the same effect was also most marked, but with the important difference that the curves were inverted, that is, high pressure years in India were represented by low pressure years in Cordoba.

In order to extend the Indian and Cordoba areas and to see how far these conditions prevailed, the pressure variations of stations as widely distributed as possible were examined. The result of this inquiry showed that the world might be divided roughly into two portions. The Indian area was found to extend to Australia, East Indies, Asiatic Russia, Mauritius, Egypt, East Africa, and Europe, while the Cordoba region might be said to include not only South and Central America, but the United States and Canada, extending further west than Honolulu.

The discovery of this barometric surge, which has been corroborated since by Prof. Bigelow, was an important advance, and will enable the investigator to connect up regions that undergo similar pressure changes.

In addition to the two periods, namely, 11 and 3·7 years, mentioned above, Brückner ("Klimaschwankungen," Eduard Brückner, Vienna, 1890) has pointed out that there is a long period weather variation. His discussion of all the available data of pressure, rainfall, temperature, &c., led him to conclude that there is a periodical variation in the climates over the whole earth, the mean length of this period being about thirty-five years.

Since this work, a recent discussion of the sun-spot data by Dr. W. J. S. Lockyer (*Proc.* Roy. Soc., vol. lxviii. pp. 285–300) has brought to light a similar long period, and this has taught us that each eleven-year cycle is different from the one immediately preceding and that following it.

A further inquiry into the distribution of the solar prominences, as observed by Respighi, Secchi Tacchini, Ricco, and Mascari (*Memorie* della Societa degli Spettroscopisti Italiani), has resulted in increasing our knowledge of the circulation of the solar atmosphere. The centres of prominence action, or the centres of the prominence belts, have a tendency to move from low to high latitudes, the opposite of spots; generally speaking, two belts in each hemisphere

exist for some time, then they couple up and move towards the solar poles, while in the meantime a new belt begins to form in low latitudes (*Proc.* Roy. Soc., vol. lxxi. pp. 446–452).

The existence of prominences in the polar regions is coincident with great magnetic disturbances on the earth just previous to or about the time of sun-spot maxima (*ibid.*, pp. 244–250). Further, these polar prominences are responsible for the existence of large coronal streamers near the solar poles, as seen during solar eclipses about the time of sun-spot maximum. In fact, recent research seems to indicate that this prominence circulation is intimately associated with all the different forms of the corona (*Monthly Notices* R.A.S., vol. lxiii., 1903).

There seems little doubt, therefore, that we must look to the study of the solar prominences not only as the primary factors in the magnetic and atmospheric changes in our sun, but as the instigators of the terrestrial variations.

In dealing with solar phenomena, especially from a meteorological point of view, it is of great importance that the solar disc be treated in zones and not as a whole.

Just as it has been shown that the prominences sometimes exist in three zones in one hemisphere at one time, so is this the case with spots, but unfortunately it is only very recently that the phenomena occurring in each hemisphere have been treated in this manner.

It has already been pointed out that a possible connection existed between changes in the spotted area of the sun and terrestrial temperatures. Quite recently this question has been studied by Charles Nordmann (*Comptes rendus*, No. 18, May 4, 1903, vol. cxxxvi.), who finds that

"The mean terrestrial temperature exhibits a period sensibly equal to that of solar spots; the effect of spots is to diminish the mean terrestrial temperature, that is to say, the curve which represents the variations of this is parallel to the inverse curve of the frequency of solar spots."

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—Four resolutions referring to compulsory Greek were submitted to Congregation on Tuesday. The resolution permitting candidates intending to read for the honour school of natural science to offer a substitute for Greek was carried by a majority of 2, the voting being 164 in favour and 162 against. The second resolution, giving the same option to honours students in mathematics, was approved by a majority of 29—the voting being 131 and 102. The two remaining resolutions providing alternative subjects for Greek in the examination in Holy Scripture, and in Responsions, were agreed to without a division. The resolutions will now be embodied in a Statute by Council, and will be submitted to Congregation and Convocation in due form.

The 255th meeting of the Oxford University Junior Scientific Club was held at the museum on Wednesday, February 3. Mr. J. F. Hornsey, Wadham, read a paper on "Photographic Films," with numerous exhibits. The following are the officers elected for this term:—President, Mr. W. E. Smith, Balliol; biological secretary, Mr. P. T. Spencer-Phillips, New College; chemical secretary, Mr. B. M. Jones, Balliol; treasurer, Mr. C. P. D. A. Pereira, Keble; editor, Mr. G. P. Poulton, Balliol.

CAMBRIDGE.—It is announced that when His Majesty the King visits the university on March 1 for the purpose of opening the new museums and medical school, he will be accompanied by the Queen and by Princess Victoria.

Mr. C. E. Inglis, King's, and Mr. A. H. Peake, St. John's, have been reappointed demonstrators in mechanism and applied mechanics.

Recent donations to the benefaction fund have raised the total to 71,658*l*. A number are specially ear-marked for various scientific departments.

The Balfour studentship, vacant by the untimely death of Mr. J. S. Budgett, will be filled up in the Easter term. The studentship is of the value of 200*l*. a year; the student need not necessarily be a member of the university, and he must devote himself to original research in animal morphology. Application is to be made to the registrary, Mr. J. W. Clark.

Dr. Guillemard, Prof. Darwin, Dr. Marr, Prof. Bury, and Dr. A. W. Ward have been appointed members of the newly created Board of Geographical Studies.

The following have been appointed electors to the chairs respectively named:—Prof. Thomson, F.R.S. (chemistry), Prof. Larmor, Sec.R.S. (Plumian of astronomy), Sir M. Foster, F.R.S. (anatomy and Downing of medicine), Prof. Allbutt, F.R.S. (botany and physiology), Mr. A. C. Seward, F.R.S. (geology), Sir William Ramsay, F.R.S. (Jacksonian of chemistry), Prof. Liveing, F.R.S. (mineralogy and agriculture), Mr. J. W. Clark (zoology), Prof. R. B. Clifton, F.R.S. (Cavendish of physics), H. Darwin, F.R.S. (mechanism), Sir Frederick Treves, Bart. (surgery), Prof. Muir (pathology).

Prof. Marshall Ward, Prof. Hughes, Mr. R. H. Adie, Mr. T. B. Wood, Prof. Middleton, Mr. A. E. Shipley, Mr. J. H. Widdicombe, and Mr. W. McCracken have been appointed examiners for the diploma in agriculture.

DR. H. KENWOOD has been appointed professor of hygiene at University College, London, in succession to the late Prof. W. H. Corfield.

IT is stated by *Science* that by the will of the late Mr. Charles F. Doe, of San Francisco, more than 100,000*l*. is bequeathed to the University of California for a library.

AMONG the names of those upon whom the Senatus Academicus of the University of St. Andrews has resolved to confer the honorary LL.D. at its annual graduation ceremony in March next are those of Prof. A. H. Keane and Prof. J. N. Langley, F.R.S.

MR. FREDERICK PURSER, fellow of Trinity College, Dublin, has, says the *Lancet*, presented a sum of 2000*l*. to the equipment fund of Queen's College, Belfast, to found a studentship in mathematics in memory of his brother, the late Prof. John Purser, of Queen's College, Belfast.

IN a pamphlet published by Messrs. Ginn and Co., Prof. J. W. Adamson, professor of education in King's College, London, deals with what he calls our defective system of training teachers. He argues that "professional training is a post-graduate business. The general, as distinct from technical, studies of the teacher are admittedly part of his professional equipment, since he cannot teach what he does not know, and mental gymnastic is at least as necessary for him as for the layman. Nevertheless, it remains true that purely technical instruction is also requisite, while the teacher's general culture, whether of the university or other type, should not be inferior in range or depth to that of the layman of similar intellectual status." He consequently urges that the general education of the teacher should be separated from technical instruction, the first being more or less completed before the second is begun.

THE following appointments are announced in the current number of the *Physikalische Zeitschrift*:—Dr. Ludwig Berend, professor of chemistry at the University of Kiel; Dr. Paul Spies, professor of physics at the Royal Academy of Posen; Prof. H. Berg, professor of mechanical engineering at the Stuttgart Technical School; Dr. Eberhard Rimbach and Dr. Georg Frerichs, professors of chemistry at Bonn; W. Wendelin, of Vienna, professor of electrotechnics and applied mechanics at Leoben; and Dr. Frederik Carl Mulertz Strömer, professor of mathematics at Christiania in succession to the late Prof. C. A. Bjerknes. Prof. Herrmann Struve is to succeed Prof. Wilhelm Förster as professor of astronomy at the University of Berlin, and Dr. Robert Freiherr Daublebsky von Sterneck has been transferred from Vienna to the chair of mathematics in the University of Czernowitz. The course of lectures at Bonn on chemistry of foodstuffs has been placed in the hands of Prof. Karl Kippenberger. The following teachers in technical high schools have been raised to the standing of professor:—R. Lutz, professor of mechanical engineering at Aachen; Dr. Carl Frenzel, professor of electrochemistry at Brünn; and Dr. Bernhard Neumann, professor of chemistry at Darmstadt.

THE first volume of the report for 1902 of the Commissioner of Education of the United States Bureau of

Education has now been published. The subjects included in the volume of 1176 pages relate to educational problems in all parts of the world, and prominence is given to the needs and condition of higher education in various countries. Among chapters likely to interest men of science may be mentioned the first instalment of a compilation of the general laws relating to colleges in the United States founded, under Acts of Congress, for the establishment and for the more complete endowment and support of colleges for the benefit of agriculture and the mechanic arts. An account of education in British South Africa reviews the facts with reference to Cape Colony, and enumerates the efforts being made in the Transvaal and the Orange River Colony to supply efficient education. Interesting particulars concerning university work in France are given in an article on education in France. It appears that the number of students in the French State universities rose from 17,605 in 1887–88 to 29,931 in 1901, of whom 3910 were registered in the faculty of sciences. It should be added that there are also in France 3500 students in State technical schools of a high order. A chapter on Italian education reveals evidence of the increasing favour in which technical instruction is held in Italy. In 1899–1900 there were 37,900 students attending the Government and private technical high schools, and of these 3000 were women. In Russia, according to an article by E. Kovalevsky, there are thirteen superior technical institutions with 8000 students. It is impossible even to enumerate the complete contents of this valuable report; it will provide students of education with material for much study and thought.

A SPECIAL subcommittee on technical instruction for women, appointed by the Technical Education Board of the London County Council, has issued a report. The subcommittee found that it could get little help from the study of foreign institutions, as the women's technical schools in Continental countries are day schools in which general education and technical training are given together. Technical classes like those carried on at London polytechnics, and work-girl students like those who attend such classes, are practically unknown on the Continent. The report first reviews the opportunities for technical instruction now open to women, and then proceeds to make suggestions for promoting further developments in such technical instruction. It is urged that, wherever possible, women teachers should be appointed for those trade classes which are reserved exclusively for women; that the attention of leading employers be directed to the action which has already been taken by certain firms in arranging for their apprentices to attend technical classes; and that the attention of girls in the elementary schools be directed to the opportunities for industrial training, and that every encouragement be offered to them to attend technical classes. Among the proposals—which number twenty-six—made by the subcommittee, a few seem of special importance. For instance, that classes be established for the training of women in hygiene and sanitation with the view of their taking up the occupation of sanitary, workshop, or public health inspectors, or of rent collectors; that in domestic economy schools more thorough instruction be given in the care and management of young children; that day classes for the training of daily servants or charwomen be conducted; and that technical day schools for girls, with a course planned to cover three years, be opened as opportunity offers.

SOCIETIES AND ACADEMIES.

LONDON.

Geological Society, January 6.—Sir Archibald Geikie, Sec.R.S., vice-president, in the chair.—On a Palæolithic floor at Prah Sands, in Cornwall: Clement **Reid**, F.R.S., and Eleanor M. **Reid**. Prah Sands lie about 7 miles east of Penzance, and have long been known as exhibiting a good section of "head" or rubble-drift, over raised beach, which rests on a wave-worn rocky platform. Recent storms have cleared away the talus at the foot of the cliff, and have exposed, between the "head" and the raised beach, a Palæolithic land-surface, consisting of loamy soil penetrated by small roots. In and above this occur black seams full of small fragments of charcoal and bone; these are particularly abundant round groups of large flat stones, which seem to have formed ancient hearths. The black seams contain implements made of vein-quartz. For a few feet above this land-surface the angular "head" consists mainly of loam with fragments of vein-quartz, some of which are worked. This seems to be the first record of Palæolithic man in Cornwall.—Implementiferous sections at Wolvercote (Oxfordshire): A. M. **Bell**. This section shows the following beds:—(1) Oxford Clay; (2) old surface, in which are pits or troughs chiefly filled with gravel and enveloped in weathered clay; (3) a large river-bed, containing gravel at the base, and layers of clay above; (4) Neolithic surface-layer, 2 feet thick. The gravel of the river-bed contains quartzite-pebbles, some of exceptional size, and is covered by a thin lenticular layer of peat and sand, yielding thirty flowering plants and many mosses; the clays over this have probably been formed in a lake, possibly due to a beaver-dam. In the gravel-bed are found implements formed of flint quarried from the Chalk, or of quartzite from pebbles of the Northern Drift, all remarkable for their size, beauty, and freshness, together with the remains of large mammals, including the mammoth. The old surface, from which the river-bed has been eroded, has also yielded implements associated with quartzites, quartz-pebbles, and lydianstone, gravel from the Thames Valley, limestone-pebbles, Oolitic fossils, and sand.

Zoological Society, January 19.—G. A. Boulenger, F.R.S. vice-president, in the chair.—A communication from Mr. Guy A. K. **Marshall**, entitled "A Monograph of the Coleoptera of the Genus Hipporhinus, Schh.," was read. It contained an enumeration of 138 known species of the genus, of which 50 were described as new.—Dr. Walter **Kidd** proposed the use of two additional characters in the description of genera and species of certain mammals. These were the arrangement of the hair on the naso-frontal region and the distribution of hair-whorls.—Dr. W. G. **Ridewood** read a paper on the skull of the giraffe, based on sections made in five different places through a skull of that animal.—Mr. F. E. **Beddard**, F.R.S., read a note on the brains of the potto (*Perodicticus potto*) and the slow loris (*Nycticebus tardigradus*), and made some observations upon the arteries of the brain in certain primates that had died in the society's menagerie.—Dr. C. W. **Andrews** read a paper on the pelvis and hind-limb of the ratite bird *Mullerornis betsilei*, and described a new struthious bird, from the Upper Eocene beds of the Fayum, Egypt.

Royal Meteorological Society, January 20.—Annual general meeting, Captain D. Wilson-Barker, president, in the chair.—The Symons gold medal for 1904, awarded to Hofrath Dr. Julius Hann, of Vienna, in consideration of his eminent services to the science of meteorology, was received by Count L. Széchenyi, First Secretary to the Austro-Hungarian Embassy, on behalf of Dr. Hann.—The **President** in his address dealt with the present condition of ocean meteorology, and began by referring to the early workers in meteorological science, Lieut. M. F. Maury in America and Admiral R. FitzRoy in England, also to the address on the same subject delivered to the society by Dr. R. H. Scott, F.R.S., in 1886. He then sketched the present state of our knowledge, illustrating his remarks by numerous maps. He reviewed the meteorological work of different nations, pointing out the energetic action of the United States in particular, and of Germany and England. He regretted the want of liberality shown by the Government in affording financial aid for the development of this important science, and in conclusion he urged the necessity of interesting the youth of the country in the matter by making it a special subject of school and college curricula.

Royal Microscopical Society, January 20.—Annual meeting, Dr. Hy. Woodward, F.R.S., president, in the chair.—The curator, Mr. C. **Rousselet**, exhibited an old microscope by Plössl, of Vienna, which had been sent on approval.—Dr. **Woodward**, the retiring president, gave his annual address, taking as his subject "The Evolution of Vertebrate Animals in Time."

Linnean Society, January 21.—Prof. S. H. Vines, F.R.S., president, in the chair.—Dr. Eric **Drabble** exhibited a lantern-slide showing diagrams of bicarpellary fruits of the French bean. The specimens of *Phaseolus vulgaris*, Savi, were obtained from a garden on the Middle Coal-measures of north Derbyshire.—The Rev. R. Ashington **Bullen** exhibited a finely preserved female specimen of the northern stone-crab, *Lithodes maia* (Linn.), from Aberdeen, and directed attention to the various organisms securely settled upon its carapace.—Biscayan plankton, part i., methods and data: Dr. G. H. **Fowler**. This formed the introduction to a series of reports from different hands dealing with the collections made by Dr. Fowler in the Bay of Biscay during a cruise of H.M.S. *Research*, and set out the objects of the cruise, the gear employed, and the records of weather, light, temperature, &c., kept in the naturalist's log.—The Crustacea obtained during the operations described in the preceding paper, entitled "Biscayan Plankton Collected on H.M.S. *Research* in July, 1900. Part ii. The Amphipoda and Cladocera, with Notes on a Larval Thyrostracan": Rev. T. R. R. **Stebbing**, F.R.S.—Dr. **Fowler** added some notes on the distribution of these Amphipoda, particularly in relation to the special points which the cruise was designed to study. No species, nor the Hyperiidea as a whole, showed any signs of the nocturnal rise and diurnal fall alleged to affect the epiplankton. Evidence was adduced to show that *Cyphocaris anonyx* and *Scina borealis* were Arctic and Subarctic forms, seeking the deep cold water of the mesoplankton at the lower latitudes of the Bay of Biscay.

Paris.

Academy of Sciences, February 1.—M. Mascart in the chair.—Presentation of the atlas of solar photography carried out at the Observatory of Meudon: J. **Janssen.** The accumulation of the material summarised in this work has occupied twenty-seven years, upwards of 6000 photographs having been taken. The lenses of the telescope, made by Prazmowski, were constructed of a flint glass specially chosen to give a maximum in the HH′ violet region, and the time of exposure was reduced to about 1/3000 second.—The action of carbon upon quicklime at the temperature of molten platinum: Henri **Moissan.** The experiment was carried out in a quartz tube, heated by the oxyhydrogen blowpipe, the material being placed in a graphite boat. It was found that an intimate mixture of finely divided quicklime and sugar charcoal was not attacked at the temperature of melting platinum, no trace of calcium carbide being formed. It was also proved experimentally that at its point of fusion calcium carbide is at a higher temperature than the melting point of platinum. —The direct reduction of aromatic halogen derivatives by finely divided nickel and hydrogen: Paul **Sabatier** and Alph. **Mailhe.** At a suitable temperature, chlorine derivatives of benzene are reduced by hydrogen to benzene in the presence of finely divided nickel. Thus at 270° C. chlorobenzene gives a good yield of benzene, with small quantities of diphenyl. Hexachlorobenzene gives a mixture containing trichloro-, dichloro-, and monochlorobenzene, together with benzene. Bromo-compounds undergo a similar reduction, but with greater difficulty, on account of the formation of nickel bromide, which is not readily reduced at the temperature of the experiment. Iodo-compounds behave in a like manner; the reaction stops after a short time on account of the accumulation of nickel iodide, but if a mixture of hydrogen and iodobenzene and pure hydrogen are sent alternately over reduced nickel at 270° C. a good yield of benzene is obtained.—Observations on the preceding note: M. **Berthelot.** The relation between the foregoing experiments and those made by the author in 1868 by means of hydriodic acid is pointed out, and the precautions necessary in the repetition of this work insisted on.—On the scapular and pelvic hands of the holocephalous fishes and in the Dipneustæ: Armand **Sabatier.**—Observations on the sun made at the Observatory of Lyons with the 16 cm. Brunner equatorial during the third quarter of 1903: J. **Guillaume.** Tables are given showing the number of spots, their distribution in latitude, and the distribution of the faculæ in latitude.—On the diminution in the intensity of the solar radiation during the years 1902 and 1903: Ladislas **Gorczynski.** The variations in the intensity of the solar radiation, previously noted at Lausanne, Clarens, Heidelberg, and at Washington, are confirmed by the author's observations at Warsaw. The first marked diminution commenced in May, 1902, the lowest point being noted in the spring of 1903. Towards the end of the year the progress of this diminution of intensity, compared with that of 1902, appeared to be arrested, although the absolute values still continue low when compared with the values for 1901. The eruptions of Martinique have been suggested as a possible cause of this diminution, but so far positive proof of this is wanting.—On systems of two surfaces the lines of curvature of which project on a plane following the same curves: M. **Guichard.** On entire functions: A. **Pellet.**—On monodrome functions and transcendental numbers: Edmond **Maillet.**—On the principle of construction of an optical apparatus for obtaining very high magnifications: C. **Chabrié.** Instead of obtaining a geometrically similar image, as is the case with the usual optical systems, the suggestion is put forward that deformed, magnified images may be used, reducing these images to their proper shape by a geometrical construction. The case of the magnification produced by a transparent cone is worked out.—The action of magnetic fields on feebly luminous sources: C. **Gutton.** Whenever phosphorescent calcium sulphide is placed in a non-uniform magnetic field it becomes more luminous, but there is no action in a uniform field. The bearing of these experiments on work with the Blondlot rays is discussed.—On the physiological action of the *n*-rays and conducted radiations: Augustin **Charpentier.** A piece of tempered steel, moved about the side of the head, the room being in semi-darkness, produces a distinct increase in the clearness with which the surrounding objects are seen, and this effect was proved not to be due to changes of refraction in the eye.—The emission of *n*-rays by plants maintained in the dark: Édouard **Meyer.** —An attempt at an experimental determination of rational clothing: J. **Bergonié.**—On manganese salts acting as oxydases in the presence of a colloid: A. **Trillat.** Colloidal solutions of manganese obtained in the presence of albumen possess the properties of an oxydase, oxidising hydroquinone to quinone, pyrogallic acid to purpurogallic acid; the oxidising properties are removed by boiling.—On mixtures of antimony and its trisulphide: H. **Pélabon.**—On an isomer of borneol, campholenic alcohol, and some campholenic derivatives: A. **Béhal.**—Some new dinaphthopyranic phenols: R. **Fosse.**—On the alkyl-allyl-ketones: E. E. **Blaise.** The general method for the preparation of ketones by the use of the magnesium alkyl compounds fails with allyl iodide, the reaction being abnormal. The author has now found that the condensation of nitriles with allyl iodide proceeds in a normal manner in the presence of zinc, and has prepared a number of allyl ketones in this way.—Oxyalkyl ethylenic hydrocarbons and acids: Charles **Moureu.** The author has isolated in the pure state a series of oxyalkyl ethylenic acids of the type $RC(OR):CH.CO_2H$ and of the corresponding hydrocarbons, and has studied the modes of decomposition of these compounds.—Researches on azo-compounds; the reduction of acetals and nitrobenzoic acids: P. **Freundler.**—The influence of the carbonic acid emitted by the soil on vegetation: E. **Demoussy.** From earlier work the author had been led to the conclusion that the rapid growth of plants under glass is not only due to the high temperature caused by the fermentation of the manure, but is largely due to the large amount of carbon dioxide given off. In confirmation of this view, further experimental evidence of the effect of an excess of carbon dioxide is now given.—On the culture of divers species of higher plants in the presence of a mixture of algæ and bacteria: MM. **Bouilhac** and **Giustiniani.** Several non-leguminous plants may profit by atmospheric nitrogen fixed by certain lower organisms, algæ and bacteria.—Organisation and morphogeny of the Tridacnæ: M. **Anthony.**—On the selection of polytaxic characters in the case of Mendelian growths: G. **Coutagne.**—Report on the development of the tracheal apparatus and metamorphoses in insects: Jules **Anglas.**—The application of the X-rays to the examination of fine pearls: Raphael **Dubois.** It is possible by means of the X-rays to examine the living oyster, and, without in any way injuring it, to see whether it contains a pearl or not. If the pearl is too small, the oyster can be returned alive for further growth.—Pollinisation experiments in *Poly-*

gonum Fagopyrum: Pierre Paul **Richer.**—On the growth in weight of plants: Mlle. M. **Stefanowska.**—On the culture of black rot: P. **Viala** and P. **Pacottet.**—On the *rôle* of phosphorus in mineral layers: L. **De Launay.**—On the presence of the Oligocene in Madagascar: Paul **Lemoine.**—On the earthquakes felt in Portugal during 1903: Paul **Choffat.** Slight earthquake shocks are frequent in Portugal, but on August 9 and September 14, 1903, that country was visited with two shocks of unusual force. The first of these affected nearly the whole of Portugal; the second was more limited in range, and it is shown that the seismic centres of both these earthquakes were in deep sea.

NEW SOUTH WALES.

Royal Society, December 2, 1903.—Mr. F. B. Guthrie, president, in the chair.—A comparison of the periods of the electrical vibrations associated with simple circuits: J. A. **Pollock**, with an appendix by J. C. **Close.** The periods of the electrical vibrations connected with narrow rectangular closed circuits have been compared with those of the oscillations associated with straight wires, with open and closed circles, and with closed ellipses. Definite numerical results have been obtained for circuits varying in length from 3 to 9 metres.—A contribution to the study of the dielectric constant of water at low temperatures: O. U. **Vonwiller.** The object of the experiments was to ascertain whether the dielectric constant of water had a maximum value at 4° C. or not. First an air condenser was used, readings being taken as its capacity was given different known values, and then a condenser having water as its dielectric, readings being taken as the temperature rose from 0° C. The capacity of the water condenser invariably decreased as the temperature rose, there being no indication whatever of a critical value at 4° C.

DIARY OF SOCIETIES.

THURSDAY, FEBRUARY 11.

ROYAL SOCIETY, at 4.30.—On the Compressibilities of Oxygen, Hydrogen, Nitrogen, and Carbonic Oxide between One Atmosphere and Half an Atmosphere of Pressure; and on the Atomic Weights of the Elements concerned. Preliminary Notice: Lord Rayleigh, O.M., F.R.S.—A New Method of Detecting Electrical Oscillations: Dr. J. A. Ewing, F.R.S., and L. H. Walter.—On the High-Temperature Standards of the National Physical Laboratory. An Account of a Comparison of Platinum Thermometers and Thermojunctions with the Gas-thermometer: Dr. J. A. Harker.—Constant Standard Silver Trial-Plates: Edward Matthey.—On Certain Properties of the Alloys of Silver and Cadmium: Dr. T. Kirke Rose.—Sun-spot Variation in Latitude, 1861-1902: Dr. W. J. S. Lockyer.

ROYAL INSTITUTION, at 5.—Recent Research in Agriculture: A. D. Hall.

SOCIETY OF ARTS, at 4.30.—Our Commercial Relations with Afghanistan: Col. Sir Thomas H. Holdich, K.C.M.G., K.C.I.E.

MATHEMATICAL SOCIETY, at 5.30. On the Roots of the Equation $\dfrac{1}{\Gamma(x+1)}=c$: G. H. Hardy.—On a Certain Double Integral: Prof. A. C. Dixon.—On an Appropriate Form of Conductor for a Moving Point-Singularity: Prof. A. W. Conway.—On Group-Velocity: Prof. H. Lamb.—On Point-Wise Discontinuous Functions of a Real Variable: Dr. E. W. Hobson.—Some Extensions of Abel's Theorem on Power Series on the Circle of Convergence: G. H. Hardy.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Transatlantic Engineering Schools and Engineering: Prof. R. M. Walmsley.

FRIDAY, FEBRUARY 12.

ROYAL INSTITUTION, at 9.—Some Aspects of Modern Weather Forecasting: W. N. Shaw, F.R.S.

PHYSICAL SOCIETY, at 8.—Annual General Meeting. Address by the president, Dr. R. T. Glazebrook, F.R.S., on the Theories of Microscopic Vision.

ROYAL ASTRONOMICAL SOCIETY, at 5.—Anniversary Meeting.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Electricity and Destructor Station at Plumstead: T. S. Nash.

MALACOLOGICAL SOCIETY, at 8.—Annual Meeting: President's Address.

SATURDAY, FEBRUARY 13.

ROYAL INSTITUTION, at 3.—Culture and Sculpture: Dr. C. Waldstein.

ESSEX FIELD CLUB, at 6.30 (Essex Museum of Natural History, Stratford).—Nature's Protection of Insect Life, with Natural-colour Photographs: Mr. F. Enock.

MONDAY, FEBRUARY 15.

SOCIETY OF ARTS, at 8.—Oils and Fats—their Uses and Applications: Dr. J. Lewkowitsch. (Cantor Lectures, IV.).

TUESDAY, FEBRUARY 16.

ROYAL INSTITUTION, at 5.—The Development of Animals: Prof. L. C. Miall, F.R.S.

ZOOLOGICAL SOCIETY, at 8.30.—(1) On the Marine Fauna of Zanzibar and British East Africa—Polychæta, Part iii.; (2) The Polychæta of the Maldive Archipelago from the Collections made by J. Stanley Gardiner in 1899: Cyril Crossland.—On some Nudibranchs from Zanzibar and East Africa—No. IV. Dorididæ Cryptobranchiatæ: Sir Charles Eliot, K.C.M.G.

ROYAL STATISTICAL SOCIETY, at 5.—Trade Union Expenditure on Unemployed Benefit: E. L. Hartley.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Forms of Turbines most Suitable for Low Falls: A. Steiger.

WEDNESDAY, FEBRUARY 17.

SOCIETY OF ARTS, at 8.—Garden Cities in their Relation to Industries and Agriculture: A. R. Sennett.

ROYAL MICROSCOPICAL SOCIETY, at 8.—On the Vertical Illuminator; the Influence of the Antipoint on the Microscopic Image shown Graphically: E. M. Nelson.—A Microscope with Geometric Slides: Keith Lucas.—Mr. C. L. Curties will exhibit Specimens of Marine Objects mounted by Mr. H. J. Waddington.

ROYAL METEOROLOGICAL SOCIETY, at 7.30.—Report on the Phenological Observations for 1903: E. Mawley.—Observations by Means of Kites at Crinan in the Summer of 1903: W. H. Dines.

CHEMICAL SOCIETY, at 5.30.—Observations on some Continuous Intramolecular and at First Reversible Changes extending over Prolonged Periods of Time: R. J. Friswell.—The Esterification of *r*-Mandelic Acid by Menthol and Borneol: A. McKenzie.

THURSDAY, FEBRUARY 18.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: Further Researches on the Temperature Classification of Stars: Sir J. Norman Lockyer, K.C.B., F.R.S.—Theory of Amphoteric Electrolytes: Prof. James Walker, F.R.S.—Note on the Formation of Solids at Low Temperatures, particularly with regard to Solid Hydrogen: Prof. Morris W. Travers.—Atmospherical Radio-activity in High Latitudes: George C. Simpson.

ROYAL INSTITUTION, at 5.—Recent Research in Agriculture: A. D. Hall.

LINNEAN SOCIETY, at 8.—Mendel's Laws as Illustrated by Wheat Hybrids: R. H. Biffen.—Heredity and Variation as seen in *Primula sinensis*: W. Bateson, F.R.S.—Formation of Secondary Wood in Psilotum: L. A. Boodle.

FRIDAY, FEBRUARY 19.

ROYAL INSTITUTION, at 9.—Condensation Nuclei: C. T. R. Wilson, F.R.S.

GEOLOGICAL SOCIETY, at 8.—Anniversary Meeting.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—Annual General Meeting; followed by Discussion on Heat Treatment of Steel.—The Motion of Gases in Pipes, and the Use of Gauges to Determine the Delivery: R. Threlfall, F.R.S.

EPIDEMIOLOGICAL SOCIETY, at 8.30.—The Etiology of Scurvy: Dr. Myer Coplans.

SATURDAY, FEBRUARY 20.

ROYAL INSTITUTION, at 3.—The Life and Work of Stokes: Lord Rayleigh.

CONTENTS.

THURSDAY, FEBRUARY 18, 1904.

MORPHOLOGY OF THE FLOWERING PLANTS.

Morphology of Angiosperms. Part ii. Morphology of Spermatophytes. By J. M. Coulter and C. J. Chamberlain. Pp. x + 348; illustrated. (New York and London: Appleton and Co., 1903.)

DURING the last decade or so the aspects of vegetable morphology have undergone an astonishing change, one indeed almost approaching the nature of a revolution. Many of the controversies of twenty years ago have now ceased to excite interest, and those old standing problems on which attention will always be concentrated have come to be regarded from other standpoints, whilst hosts of new ones have hustled themselves to the front. Several causes have contributed to effect this change in the whole perspective of the science. The introduction of more precise methods of observation and experiment has resulted in the disintegration of more than one cherished superstition, but it has been at the same time fertile in good results by leading to a re-examination of the foundations of our morphological beliefs. Our horizon has been greatly extended by the remarkable advances made in palæontology and cytology, and we have been thus enabled to link together many facts and phenomena the connection of which had hitherto been unsuspected or at the best but guessed at.

Sooner or later the newer points of view come to be reflected in new types of text-books. The volume before us is one of these pioneer works. It makes no pretence of dealing with the whole range of so vast a subject as that of the morphology of angiosperms, but the authors have wisely selected, out of the mass of information at their disposal, such material as may illustrate the main thesis they had in view in writing the book. This thesis might perhaps be fitly described as the angiosperms from a phylogenetic standpoint. The whole treatment converges to this end, including also the somewhat curtailed account of angiospermic anatomy separately contributed by Prof. E. C. Jeffrey.

Naturally the different portions of the work are of unequal value; this is partly to be attributed, as in the case of the later geological evidence, to the comparative exiguity of trustworthy information, and in part also, perhaps, to considerations of space.

The general character of the treatise may be gathered from the headings of the earlier chapters. Thus we find the microsporangium, the megasporangium, the female gametophyte, fertilisation, the endosperm, all receiving a full treatment in separate chapters. Other important phases in the life-history of a typical angiosperm are similarly dealt with, and each phase is treated from a comparative standpoint.

One of the most interesting discussions, at least to an advanced student, is that on the phylogeny of the two main divisions of the angiosperms. The various probabilities are ably put forward and sifted, and after reviewing the whole, the authors are inclined to consider the dicotyledons as having sprung from a stock distinct from that which gave birth to the monocotyledons. They are inclined to regard the unquestioned similarity in the stages characteristic of the germination of the embryosac, in the two phyla respectively, as being attributable rather to convergence than to community of origin, much in the same way, perhaps, as we now recognise heterospory to have appeared independently in all the advanced groups of vascular cryptogams. But in this instance, as in others in which there is also room for great divergence of opinion, one cannot fail to be struck by the fairness with which they present the evidence, even when it militates against their own particular view.

The angiosperms as a whole are likewise considered to have originated independently of the gymnosperms, in spite of the apparent points of contact exhibited, *e.g.* by the Gnetaceæ in certain of their reproductive structures, with the higher group. The differences are held to be of such moment as to be irreconcilable with any close affinity, and the authors emphasise their position by proposing to retain the term spermaphyte as one of mere convenience, and not as in any way implying near relationship. Probably many will agree with this attitude of caution in the absence of more palæontological evidence than we at present possess, and it is at any rate clear that modern work has sufficed to accentuate the remoteness of the gymnosperms, not only from the dicotyledons with which they were formerly grouped, but from the whole angiospermic class.

It cannot, of course, be expected that all the theoretical interpretations and conclusions advocated by the authors will commend themselves with equal force to other botanists, and we find ourselves unable to follow them in all their proposed modifications of terms. Thus it does not appear to be a substantial gain to limit, even implicitly, the term *dioecious* to the gametophyte. The word is perfectly well understood in connection with the sporophyte, and if we accept (as it seems reasonable to do) their own conclusion that the spore-mother cell is the point at which the sporophyte generation terminates, the term may still serve according to the current use. For if the gametophyte is regarded as being inaugurated on the division of the spore-mother cell, the spores themselves, produced within the tissues of the sporophyte, form an early stage of the sexual generation. This view is based on the important nuclear changes associated with the formation of the spores, and it has already been adopted, at least in this country, as a cardinal point in the life-history of the higher plants. The objection raised against the terms gynæcium and andrœcium by reason of their conveying a significance as to sex is quite parallel to the one before mentioned; but no one would regard the term male or female, as applied to an animal, to be incorrectly used on the ground that the sexual elements are the real male and female cells. The matter is not affected by the fact that these tissues are often segregated from the soma at so early a period, and with such definiteness, that many zoologists have concluded that there is a fundamental dis-

tinction between soma and sexual tissues comparable with that which in plants finds its expression in alternation of generations.

On the other hand, the proposal to replace the expression "double fertilisation" by that of "triple fusion" strikes us as a good one. It is by no means certain that the process indicated is really of the nature of fertilisation at all, and until more evidence enables us to form a reasoned opinion as to the meaning of these remarkable phenomena that precede the formation of endosperm in a large number of cases, it is better to avoid taking up, even nominally, what may prove to be a totally untenable position. Indeed, we already know that endosperm may arise, in some instances, independently not only of the addition of the extra male nucleus but also even of the fusion of the two polar nuclei themselves.

It is not possible to discuss the many points raised in this interesting work in any detail. Every serious student of botany will certainly peruse it for himself and can form his own judgment on controversial matters. He will be aided in this by the copious references to literature which form not the least valuable feature of this fine book.

Here and there we note an occasional slip, *e.g.* the suggestion that the investigations which have led to a general disbelief in the occurrence of centrosomes in angiosperms originated in Germany. But as a general rule the statements are remarkably free from inaccuracy. It is not possible to conclude this notice without commenting on the excellent manner in which the book is got up. The text, and especially the illustrations, both in character and execution, are all that could be desired.

J. B. F.

APPLICATIONS OF PHYSICAL CHEMISTRY.

Physical Chemistry in the Service of the Sciences. By J. H. van 't Hoff. Edited by Prof. Alexander Smith. Pp. xviii + 126. (The University of Chicago Press, 1903.) Price 1.50 dollars.

THIS handsome volume is based on a course of nine lectures delivered in 1902 at Chicago, where Prof. van 't Hoff was the guest of the university; it deals with the extension of Avogadro's law to solutions, and the thermodynamical principle of the conservation of energy; the thermochemical and electrical methods of determining what chemical changes are able to do work, and the theory of ionisation; the application of the phase-rule in relation to the extraction of pure salts from the Stassfurt deposits, and to the metallurgy of iron and steel; osmotic pressure in its physiological applications, and the catalytic action of enzymes; and the nature of the salts deposited by the evaporation of sea-water, and the reasons for their formation. The lecturer has thus, by carefully chosen examples, illustrated the bearing of modern physical chemistry on manufacture, on physiology, and on geology.

Prof. van 't Hoff tells a curious tale of the celebrated Kekulé, professor at Bonn, who thirty years ago took the pessimistic view that chemistry, as a science, had come to a stand, and that a Newton was necessary before further advance could be made. It was an unfortunate utterance, for no science has made greater strides within the last quarter of a century, and Prof. van 't Hoff has done much to contribute to its advance. The fortunate conjunction of three men, van 't Hoff with his magnificent powers of generalisation, Arrhenius with his keen insight, and Ostwald with his encyclopædic knowledge and rare gift of exposition, has largely aided the rapid progress of physical chemistry. But the first step was taken by van 't Hoff and Le Bel, in their simultaneously conceived theory of the representation of the molecule in three dimensional space.

In discussing the aid which physical chemistry has given to pure chemistry, the author states:—

"The most recent development of physical chemistry has been characterised rather by the establishment of comprehensive principles which fertilise the whole foundation of the science, and which promise to furnish nourishment for a large part of the chemistry of the future."

A short explanation of the nature and laws of osmotic pressure is then followed by a brief statement of the nature of a reversible cycle and its application to the case of carnallite. The "principle of maximum work" is next considered, and the fallacy contained in it, and the suggestion is thrown out that all thermochemical work should be repeated, "with the object of determining the ability of each reaction to do work." This suggestion is again illustrated by help of carnallite as an instance. At 21°, the temperature of equilibrium between carnallite and its components,

$$MgCl_2KCl.6H_2O + 6H_2O \rightleftharpoons MgCl_2.12H_2O + KCl,$$

the possibility of doing work is zero. But above this temperature, the reaction can overcome a resistance such as a pressure; hence $dE = -WdT/T$, and a cyclic change is possible. For finite values $E = -W\Delta t/T$; hence, while at the transition temperature where $\Delta t = 0$, $E = 0$, both above and below it the sign of E changes. Of course, at absolute zero, $E = W$, where $\Delta t = -T$, and the heat developed will be a measure of the capacity to do work, and the fact that Berthelot's principle of maximum work holds in many cases is merely due to the temperature of experiment being relatively low—only 273° above absolute zero. At 1000°, on the contrary, acetylene is formed with absorption of heat, and water decomposes in spite of the fact that its formation is accompanied by evolution of heat. This abridgment of van 't Hoff's argument will give an idea of the simple and clear method of statement. In a similar manner the connection of the capacity to do work with electromotive force is explained, and illustrated by the example of a thallium–thallium chloride–potassium thiocyanate cell. Arrhenius's conception of ions is thus introduced and shortly described.

In dealing with the connection between physical and industrial chemistry, van 't Hoff emphasises the circumstance that in Germany the most hearty cooperation exists between manufacture and science, alluding to the fact that it is not there expected that the physical chemists shall give "tips" to the in-

dustrial chemists, but that the education of the latter as physical chemists will open up new points of view, and gradually lessen the purely empirical methods by which the industrial chemist often tries to progress. The salt industry is next discussed; this is followed by an exposition of Cohen's experiments on allotropic tin, a short and masterly exposition of the metallurgy of iron, and the relations between α and β ferrite, pearlite, cementite, and carbon.

In considering the bearing of physical chemistry on physiology, the measurement of osmotic pressure by *tradiscantia discolor*, and by blood-corpuscles, and the curious experiments on the human eye by Dr. Massart are discussed, as well as Loeb's discovery of the *rôle* of osmotic pressure in fertilisation. The influence of enzymes as accelerators or retarders of chemical action, and their effect in promoting synthesis as well as decomposition are particularly alluded to.

The last chapters, dealing with geological phenomena, are suggestive; the type chosen is the very complicated relationships between the Stassfurt salts, in which no fewer than twenty-six components are present. A graphic representation of the conditions under which these salts are capable of existence is annexed.

Prof. van 't Hoff possesses in an almost unique degree the power of simple exposition and suggestiveness. On reading this book one is tempted to exclaim, "Why was all this not thought of ages ago?" But the fact is, all great discoveries can be simply stated, but it usually needs a great discoverer who can add to his discoveries simple methods of exposition. The magic consists in clearness of thought, and this is admirably illustrated in this interesting book.

W. R.

SCHOOL MATHEMATICS.

A School Geometry. Parts i.–v. By H. S. Hall, M.A., and F. H. Stevens, M.A. Pp. xii+340+ix. (London: Macmillan and Co., Ltd., 1903.) Price 4*s*. 6*d*.

Exercises in Theoretical and Practical Geometry. By R. B. Morgan. Pp. 96. (London: Blackie and Son, Ltd., 1903.) Price 1*s*.

Graphs: or the Graphical Representation of Algebraic Functions. By C. H. French, M.A., and G. Osborn, M.A. Pp. vii+64. (London: W. B. Clive.) Price 6*d*.

PART V. of the new geometry by Messrs. Hall and Stevens has been recently issued, and the whole work, so far as it is completed, is now conveniently published in one volume. The final part, dealing with solid geometry, is in preparation, and will be awaited with interest in many quarters.

The authors follow the reform movement cautiously, on strictly orthodox lines, and adhere closely to the recommendations of the Mathematical Association and to the new Cambridge syllabus. The advantages of the newer methods of teaching geometry are very manifest in this excellently written text-book. A great change has been effected in the country in a comparatively short time, but the subject is not yet sufficiently emancipated from the older influences. The field of elementary geometry is at present only partially covered. We are strongly of opinion that examiners, teachers and writers should take a more comprehensive view of the scope of the subject. The scheme still generally followed in schools deals only with the shapes and sizes of figures, and takes no account of their relative positions. That is, attention is confined to scalar properties, and a vital portion of this essentially vector subject is ignored. It seems to us that boys at school should receive some account of the geometry of space, that is, they should be introduced to the conception and domain of vectors. This domain is far reaching and of supreme importance, and in subsequent study is seldom fully comprehended because, in the supposed interests of logic, persons responsible for the teaching of geometry have neglected a part of their duties and have failed to treat the subject in a thorough manner. The foundation of a knowledge of vectors should be laid in the geometry and drawing classes, where it can be done appropriately and effectively, and able writers like the present authors could exert much influence for good by introducing the subject in their deservedly popular text-books.

Mr. R. B. Morgan's book consists of a collection of more than six hundred exercises in geometry, together with a few specimens of recent examination papers, the purpose of which seems to be to illustrate the course of geometry as outlined in the new Cambridge schedules. No answers are given to the examples, or hints for solution or explanations of any kind, and the book is only adapted for use in conjunction with an ordinary text-book. In the latter sufficient examples are usually provided, and generally of a superior merit to those under review, so that the sphere of usefulness of Mr. Morgan's book seems likely to be very restricted.

The text-book by Messrs. French and Osborn is one of the University Tutorial Series. It is a supplement to the "New Matriculation Algebra" of the series, and is intended primarily for students preparing for the London matriculation examination. The subject is introduced by some typical examples of statistical graphs, in which special attention is paid to the choice of scales and the kind of information to be obtained from graphs. The authors then at once proceed to the development of the properties of algebraical functions by means of graphs, the examples being confined mainly to equations of the first, second and third degrees. The problems dealt with relate to maxima and minima values, the solution of equations, limiting values and asymptotes, symmetrical properties, and the determination of algebraical curves to pass through two, three, or four points.

It will thus be seen that trigonometrical, exponential and logarithmic functions are outside the scope of the work, as are also considerations relating to slope, rate of increase, and the calculus. But the ground that is mapped out by the authors is well covered, and the book will be found very useful to the class of students for whom it is intended.

OUR BOOK SHELF.

Eton Nature Study and Observational Lessons. Part i. By M. D. Hill and W. M. Webb. Pp. x + 155. (London: Duckworth and Co., 1903.) Price 3s. 6d. net.

THERE is no doubt that nature-study ought to take an important place in education, but, if it is to be of use, it must be set about in the right way. If the boy is merely told certain wonderful facts, he swallows them as a whale swallows small fry, and waits open-mouthed for more. They are soon forgotten, he acquires no good mental habit, and the net result is very small.

The authors of this book have adopted a different plan. The boy has presented to him some natural object, such as a plum, a seed-pod, a sea-anemone, a crab, a sycamore leaf, mould, a mushroom, a blind-worm, a hedgehog, a bulb, a log of wood, a branch, a growing bud, a seedling, a leaf. On these he writes notes, which are partly answers to definite questions put to him and partly other observations which he makes unaided. He is being trained to observe for himself. The variety of subjects over which the book ranges is an excellent feature. Besides those already mentioned, there is the sun; by means of a simple piece of apparatus he sets about observing its apparent movements.

If the book ended with these observational lessons it would be very defective. A boy is by instinct a hunter. It is the hunting instinct that leads him to chase a butterfly, and he impales it lovingly on a pin and sets it and preserves it rather as a trophy than as a specimen from which something is to be learnt. The thing is to guide this hunting and collecting instinct. An attempt at this is made by means of the suggested outdoor studies which are interspersed among the observational lessons. For example, a little information is given about the dispersal of seeds by means of the plant's own catapults, or by the help of the wind or of animals. Fired by this knowledge the young naturalist (or rather boy that is to be converted into a naturalist) is to go out and collect illustrations of these various methods. He is also taught how to make a sundial, on the understanding that he is to set to work to make one for himself. He is encouraged to keep an aquarium (salt-water or fresh-water), to study clouds and spiders' webs, to collect and identify leaves in autumn, to make observations on fungi, British mammals, domestic mammals, to make a bird calendar, to inspect the bark of trees and the characters of timber. Rocks and fossils are not left out. Certainly it is his own fault if he becomes a narrow specialist before he is out of his teens.

The observational lessons will benefit all who are privileged to be taught in this way. The suggested studies will be helpful to those who have more than the average keenness. Summing up, we may describe it as a book that will teach the teacher how to set about his work, and that will thus be highly useful. The illustrations, with the exception of the one on p. 91, are good and really illustrative.

Camera-Kunst. Eine internationale Sammlung von Kunst-Photographien der Neuzeit. Unter Mitwirkung von Fritz Loescher. Herausgegeben von Ernst Juhl. Pp. viii + 107. (Berlin: Gustav Schmidt, 1903.) Price 4s. 6d. net.

IN these 107 pages the compilers have brought together a series of essays which gives the reader a good idea of the camera art as practised in various countries. The idea in this work has been to request some photographers, well known in their own countries, to contribute each a chapter dealing with the present state of photography in their respective countries from the point of view of art, and the result is an interesting set of opinions. Those who have written for this volume are Ernst Juhl, Hamburg; Edward J. Steichen, New York; Fritz Loescher, Berlin; Robert Domachy, Paris; Otto Scharf, Krefeld; Alfred Stieglitz, New York; Dr. Adolf Thiele, Kappel-Chemnitz; W. Bandelow, Krackow; and J. C. Warburg, London. With the increasing development of art-photography such a book as the one before us will undoubtedly be of interest to the widest circle of photographers whether amateur or professional. Not only are the opinions of each contributor given in words, but in every case a series of excellent illustrations is added showing the various styles and types of pictures of well-known photographers. Thus, to take the case only of those exhibiting the British types, we have examples of the work of Warburg, Horsley-Hinton, W. A. Stewart, Page Croft, Archibald Cochrane, Craig Annan and Alexander Keighley.

Enough perhaps has been said to acquaint the reader with the kind of book he has here to deal with. When it is mentioned that the get-up of the book is, on the whole, excellent, although attention may be drawn to some of the illustrations which are somewhat spoilt by the printing on the back, photographic readers will be sure to find it a valuable addition to their literature.

The Arcadian Calendar. By E. D. Cuming and J. A. Shepherd. Pp. xii + 215; illustrated. (London: G. Newnes, Ltd., 1903.) Price 6s. net.

FROM the humorous character of the illustrations it would be quite reasonable to suppose that in this entertaining little volume natural history subjects were discussed from the comic point of view; and, indeed, this was the opinion entertained by the present writer when these essays appeared in their original form as articles in the *Strand Magazine.* No greater mistake could be made; for, as a matter of fact, the observations on the habits and mode of life of the beasts, birds, fishes and invertebrates of the British islands recorded in its pages are remarkable for their accuracy as well as for their general interest. Mr. Cuming, the author of the letterpress, is, we believe, chiefly known to the public as a writer on sporting subjects; but he is evidently a keen and appreciative observer of animated nature, and he has our best congratulations on his appearance in a new *rôle.*

As its title implies, the work treats of the ways of animals at different seasons of the year; and in the section devoted to the winter months we find collected certain observations which, to ourselves, at any rate, are new. For instance, the fact that both birds and mammals may, in exceptional circumstances, become frozen to the ice on which they are resting is not mentioned in any natural history work with which we are acquainted; while the observations on the reason why many birds roost in company, if not novel, are at least interesting. Neither must we omit to refer to the author's explanation of the present relative scarcity of swallows and martins in this country; this scarcity being attributed partly to the numbers and aggressive habits of the British sparrow, and partly to the slaughter of swallows, as an article of food, by the inhabitants of southern Europe.

As to the illustrations, which are exceedingly clever and excellent of their kind, it is probable that they appeal more closely to the popular taste than they do to our own. Conjointly, the author and the artist have succeeded in producing a dainty and attractive volume, which ought to command a large sale as a gift-book.

R. L.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* Nature. *No notice is taken of anonymous communications.*]

The Victoria Nyanza Jelly Fish.

In a note occurring in your last issue (p. 348), mention is made of an interesting fact with which zoologists have for some time been familiar, namely, that the medusa characteristic of Lake Tanganyika exists at present in the Victoria Nyanza also. As it seems to be suggested that this discovery is in some way or another adverse to the theory of the origin of a portion of the fauna of Tanganyika for which I have been responsible, you will perhaps allow me space to point out that, so far from the fresh knowledge being in any way antagonistic to the view in question, the existence of the jelly fish in other lakes beside Tanganyika is exactly what one would, and did, anticipate, supposing the halolimnic theory to be correct.

The medusa in the Victoria Lake is identical with that in Tanganyika, and its presence in the former can be explained in two ways.

It may have, so to speak, existed there from all time, in which case the rest of the halolimnic fauna, or at least a part of it, should be found along with the jelly fish. In this case we should have a confirmation and extension of the view which I have already put forward, that the ancient sea from which the halolimnic "relic" sprang spread much further towards the east than was at first supposed.

It is, however, quite possible that the medusa has been recently transported to the Victoria from Tanganyika, owing to the opening up of the new trade routes, and the carriage of water in gourds and other vessels from one basin to the other.

This second view, to me, seems extremely likely, and it is certainly supported by the fact that the Victoria jelly fish is identical with that in Lake Tanganyika. Had it been long isolated in the former lake it would almost certainly now have presented specific differences, just as the fresh-water shells of the Victoria differ slightly from those of the neighbouring lake basins. J. E. S. Moore.

Royal College of Science, London.

The Blondlot n-Rays.

There can be no doubt that the results obtained by M. Blondlot and others at Nancy are most remarkable, even if they should prove to be, as Herr Lummer's communication to the Berlin Physical Society would lead us to suppose, purely subjective, or, as he prefers to put it, "objective phenomena in the retina."

I have endeavoured to repeat M. Blondlot's experiments, but quite without effect, using calcium sulphide screens of the dimensions he suggests, that is, about 16 mm. by 2 mm.

A thin layer of gum is spread over a sheet of cardboard and the powder sprinkled over the surface until as large an amount as possible adheres to the screen. No difference in the colour or intensity of the phosphorescent glow appears to take place when a lead screen or the hand is interposed between the phosphorescent screen and an Auer burner completely enclosed in a tin-iron box with an aluminium window, nor does the interposition of a quartz lens in various places have any effect.

A very much larger screen was exposed to the Auer burner, one half being screened with lead and the other with thin aluminium, so that only the latter half was exposed to the radiation of the n-rays. The luminosity of the screen was, however, quite uniform throughout, although a sharp line ought to have separated the two parts of the screen, as the intensity of the phosphorescence should have been different in the two sides.

I am at a loss to find any other explanation of M. Blondlot's results than that he has come across a radiation to which some men are blind and others not so.

Self-hypnotism due to fatigue of the optic nerve may account for results of one observer alone if he were to manipulate the lead screens and to make observations at the same time, but I think that M. Blondlot will have taken the precaution to get others to work the screens for him whilst he observed, and then compared results.

I may perhaps venture to note that a few years ago, in the course of some photometric work with fluorescent bodies, I was led to try whether one fluorescent body would increase or diminish the brightness of another (*Phil. Trans.*, vol. cxci. p. 92), but could not detect any such change within the errors of observation.

The fact that M. Blondlot has actually measured the wave-length of the n-rays leaves little doubt (in my mind) that what he has observed is, in the true sense, an objective and not a subjective effect, but at the same time the fact also that so many others who have tried in apparently the same way have failed, and failed deplorably, leaves still less doubt that the precise conditions upon which the effect depends yet remain to be discovered. John Butler Burke.

Cavendish Laboratory, February 8.

Radiations producing Photographic Reversal.

In a paper read before the Röntgen Society last December I pointed out that the β or γ rays from radium are capable of producing photographic reversal—a result more recently confirmed by Mr. Skinner, of the Cavendish Laboratory.

Since that particular property, shared by radiations generally, appeared likely to furnish a test of use in discriminating between rays of various kinds, I have examined also the reversing effect of polonium emanation upon photographic plates.

I find that these rays are capable of reversing pressure marks, but are unable to modify the action of X-rays or daylight upon the plate. Neither will they, even with prolonged exposure, show any tendency to reverse their own photographic effect, as happens in the case of light or rays from radium.

It is remarkable that, in their power of inducing photographic reversal, X-rays and the emanation from polonium appear to behave in a similar manner.

Charles E. S. Phillips.

Shooters Hill, Kent, February 15.

Radium Débris.

The valuable summary of "Researches Relating to Radium" in your issue of January 28 contained the following paragraph:—"From the disintegration theory it followed that the accumulation, during past ages, of the final products of the change of the radio-active elements must exist in the natural minerals in which these elements are found," also that helium was likely to be a product of the change.

It is the final products of the disintegration which are interesting, for if the disintegration has been going on for untold ages it is likely that other elements may have been produced from the atomic débris. It seems quite certain that radium belongs to Group ii. of the periodic classification, and no doubt to the calcium family. Is it not possible that this disintegration which has been going on for ages has given us one final "elementary" product in the shape of calcium? The close connection between the atomic weight of helium (4) and the atomic weight of calcium (40) suggests such an idea. Moreover, if one puts hydrogen in its position in the periodic classification, justified by its atomic weight, then helium comes into Group ii. along with the calcium and radium. Now, although it has hitherto been the rule to look upon the heavier elements as products of the condensation of some fundamental light substance, does not this atomic disintegration suggest that the lighter elements may be regarded as products of the breaking up of the heavier ones? When one looks at the list of elements, the small number of heavy elements impresses the mind, and the abundance of the lighter ones, those which one may regard as the final products in atomic disintegration, is well in evidence. The polymerisation of the original products of atomic disintegration may be responsible for some of the numerical relations among atomic weights.

However, attention need not be confined to the natural minerals in which the radio-active elements exist in order to

find the products of their change, but the atomic débris should rather be sought in all the materials of the earth's crust. What we have now of radio-active elements may be residues. JOHN B. COPPOCK.

Science Schools, Stroud.

Phosphorescence of Photographic Plates.

HAVING seen in NATURE several letters on the above subject recalls to my mind some experiments made by me two years ago. I first observed it after developing X-ray plates, and mentioning the matter to Prof. Poynting, of the Birmingham University, he advised me to pursue the subject further.

I subsequently found that the same phenomena were exhibited with a photographic plate, whether previously exposed to light or not. I observe that your correspondent, Mr. Bloch, says, that he "chanced to empty some spent pyro developer and a dilute solution of alum into the sink of the dark room at the same time, when the whole liquid at once glowed with a brilliant phosphorescence."

By "spent pyro," I presume that he attributes the phosphorescence to the influence of the silver salt of the plate upon the solution.

May I point out that the phosphorescence is exhibited by the mixed pyro and soda solutions in an ordinary white developing dish, without any contact whatever with any photographic plate or paper, and without adding any other salt; but that the phosphorescence is not so brilliant, and takes a longer time before it can be seen?

The phosphorescence is distinctly seen by pouring the solution of pyro and soda into the dish, allowing it to remain a few minutes, and pouring it away so that only a few drops are left on the dish.

I tried to obtain a photograph of an object between the luminous dish and the camera, but without success.

My friend, Dr. Martin Young, of Birmingham, who is an ophthalmic surgeon, and accustomed to deal with optical phenomena of a delicate nature, being particularly sensitive to the faintest luminosity, in assisting me was able to localise the position of the dishes and even of glass measures containing the solutions in the dark room where no photographic plate had been in contact with the liquid.

We concluded that the phosphorescence was entirely due to the process of crystallisation taking place in a thin layer of liquid. WALTER J. CLARKE.

Gravelly Hill, Near Birmingham, February 9.

Hering's Theory of Heredity, and its Consequences.

UNTIL lately I supposed, with most biologists, that the phenomena of heredity and variation were facts which we were quite unable to explain. But having had occasion to study the subject once more, I have found in Prof. Hering's[1] address on "Memory as a General Function of Organised Matter," delivered to the Imperial Academy of Sciences at Vienna on May 30, 1870, the germ of a theory which simplifies everything, and throws quite a new light on the problem of variation. In fact, when carried to its full extent, it reduces our difficulties almost to the everlasting mystery of the nature and mode of action of mind, a mystery which can never be solved.

This address passed almost unobserved in England at the time of its delivery. It was noticed by Prof. Ray Lankester in NATURE of July 13, 1876 (vol. xiv. p. 237), when reviewing Prof. Haeckel's "Hypothesis of Perigenesis," but it is not mentioned in Darwin's letters. In 1878 Mr. Samuel Butler published his book "Life and Habit," in which the same theory is independently advocated, followed in 1880 by "Unconscious Memory." Owing to several causes these books did little if anything to advance the theory, but in "Unconscious Memory" Mr. Butler gave a translation of Hering's address, and subsequently another translation was published in "The Religion of Science Library" (*Open Court* Publishing Co., Chicago), which reached a second edition in 1897, so that probably it is attracting more attention in the United States than in England.

Prof. Hering's theory is as follows. Memory, he says, is the faculty of reproducing old ideas or sensations. Often it is a conscious act, and we call up a memory voluntarily; but sometimes these memories come spontaneously, even when we do not wish for them. To account for this we must assume that the original idea or sensation made some material alteration in the substance of the brain, vestiges of which remain, and the nervous substance is enabled to reproduce the idea at will. These material vestiges are not permanent, but fade away unless they are strengthened by repetition, although by constant effort we can recall memories with great precision.

However, conscious memories, whether voluntary or not, form but a small part of our life. They emerge but occasionally from the mass of unconscious memories, or habits, by means of which we carry on all the daily operations of eating, moving, talking, &c. In all these cases it is the unconscious memory which tells us what to do and guides our actions. Habitual performance of an action makes it easy, and after constant repetition it becomes unconscious or automatic. This would not be possible if the nervous system was unable to remember and reproduce former states of irritation, and when habits are transmitted from one generation to another they are transformed into instincts.

But memory is not confined to the central nervous system. The unconscious memory of the sympathetic system is as strong as that of the brain, and we can recognise automatic or reflex action even in a single ganglion. Indeed, the minute Protozoa, such as Vorticella, which have no nervous tissue, show irritability, which is only a form of reflex action, so we must acknowledge that they also have memory and instincts. Even plants have instincts. The roots grow downwards and stems upwards by instinct. It is instinct that makes the ivy grow towards the shade and the clematis towards the light.

Now we cannot draw a line between instinctive action and heredity. When a corpuscle of protoplasm divides, if the two halves separate we call it an instinctive or automatic action, if they remain together it is heredity. When a gnat bursts its larval skin and flies away, the flying may be called a voluntary action; the bursting of the skin is involuntary and instinctive, but so also is the formation of the skin.

But how can habits or structural variations be transmitted from one generation to the next? Prof. Hering gives the following explanation. The nervous system, he says, is a coherent unity, probably connected with every cell. Any irritation effected in one part is repeated by the others, and these repetitions would probably be stronger in the reproductive cells than elsewhere. The reappearance of the parent in the full-grown offspring can only be due to the reproduction of such experiences as the germ had previously taken part in while still in the reproductive organs. The offspring remembers these experiences so soon as the same or a similar irritation is offered. If the germ-cells of the parent organism are affected, however feebly, by the habits of the body, then the offspring, as it grows, will reproduce the experiences it underwent as a smaller part of the body. Therefore it accurately repeats what its ancestors have repeated through innumerable generations. When the first germ divided it bequeathed its properties to its descendants, the immediate descendants added new properties, and every new germ reproduced to a great extent the *modi operandi* of its ancestors. Each generation endows its germ with some small property which has been acquired during life, and this is added to the total legacy of the race. Thus every living being of the present day is the product of the unconscious memory of organised matter.

Such is Prof. Hering's theory of heredity and variation. I have rearranged the argument, condensing in some places and enlarging in others, but it is essentially the same as when he announced it thirty-three years ago. It has been said, on high authority, that Prof. Hering has merely substituted the term "memory" for the "polarity" of Mr. Herbert Spencer. But this is hardly correct, for Prof. Hering, by showing that heredity is a series of reflexes, each one of which acts as the stimulus to the next, has substituted a fact for a metaphysical conception, and in doing so has brought heredity into line with instinct and habit, the last of which we can understand to some extent. Of course there are difficulties in the way of accepting the

[1] Prof. Ewald Hering, F.R.S., Director of the Physiological Institute at Leipzig.

theory, but before considering them let us see how Hering's theory affects our ideas of variation.

In the first place it gives an explanation of the definite variation which we see in the development of non-adaptive or useless characters. A variation, once started, would in the future have a tendency to be reproduced, and this tendency would get stronger and stronger as the memory is reinforced by repetition, and when once established the variation would be quite definite. New variations may be indefinite, but they must either die out or become definite; and we see by Hering's theory why useless characters may be as constant as useful ones, for constancy depends upon the number of repetitions and not on the nature of the variation or on the reason for its survival. This includes, of course, use-inheritance, for according to the theory, when an organ is constantly exercised the memories of the component parts are strengthened, and in the next generation the organ is reproduced better developed than in the last. It is the same with instincts; they are the inherited modifications of mental operations, while a structural development is due to the inherited modifications of physical operations. When an organ is not used the memories of the parts are weakened, and in the next generation the organ is reproduced in a more feeble condition, until at last it is not developed at all, the memory of the operation having been lost. The process is exactly the same as the gradual loss of an instinct from disuse; both are due to forgetfulness.

With regard to the action of external causes, Hering says that each generation endows its germ with some characters acquired during life. But we cannot suppose that adaptations to new circumstances are directly produced by the action of the surrounding conditions. For example, the fur in many animals gets thicker in cold climates and some plants get spiny coverings in dry climates. These cannot have been directly produced by the action of the climate, but must be due to the action of the protoplasm resisting the climate. Dry air could not directly produce the spines on a plant any more than it could produce the water-pouches in the stomach of a camel. Neither could feeding on nectar have produced the honey-bag of a bee, for it would be absurd to suppose that sucking liquid through a tube could cause a projection to grow out of it. We might as well say that rain and wind build houses or that snowstorms make great-coats as to suppose that the action of external influences made the cell-wall or the thick fur. Evidently it is the living protoplasm which originates these adaptations to protect itself from the rough elements or to prevent itself from being poisoned or starved. But how variations originate, whether they be intelligent and purposive, or whether they be blind, haphazard gropings after some change when the protoplasm feels uncomfortable, Hering's theory does not tell us.

There are other facts connected with variation which are explained by Hering's theory. As the germ contains two different memories, derived from its two parents, these may clash and antagonise each other, and so allow an older but dormant memory to be stimulated into activity. This is atavism. Or degraded characters which have suffered from disuse can, on a renewal of the old stimulus, again be recalled, as we see in proteus, which gets dark in colour when kept in the light. Prepotency can also be explained on the supposition that the germ of one parent has stronger memories than that of the other; and the reproduction of lost parts may perhaps be due to the memory of the remaining portions trying to replace the lost portion. In the same way we see that mutilations could not produce degeneration or the loss of a part, no matter for how many generations they may be carried on, because the part develops and the stimulus has been given before the part is removed. Again, the fact that variations appear at an earlier stage in the offspring than in the parent may be taken as evidence that they are due to an excited memory which anticipates events. But I do not see how Hering's theory can explain the infertility of hybrids. Conflicting memories might lead to inaction, but I cannot see why these conflicting memories should arise until the time had come to differentiate the embryo into the form of one or other of the parent species. This would give rise not to sterility, but to abortion, while it is thought that the fœtus generally perishes at an early stage of development.

Now let us consider the obstacles to believing in Hering's theory.

In the first place it may be objected that it is impossible to suppose that the small ovum, or still smaller spermatozoid, could contain all the memories necessary for building up the adult organism. This is an objection which applies to all hypotheses except epigenesis, and it is of considerable weight. However, the capacity of the germ-cells for storing up memories is not unlimited. It is only very few indeed of the impressions stored in the brain that are also registered in the germ-cells, and this, I think, is favourable evidence.

Next we have the difficulty of understanding the transmission of variations from different parts of the body to the germ-cells. This difficulty also is not peculiar to Hering's theory, but is common to all, and however difficult it may be to understand, we know that, with instincts, it is a fact. Darwin certainly said that it was an error to suppose that instincts were inherited habits, for they were due to natural selection. Romanes, following him, said that some instincts owed their origin to natural selection, while others were inherited habits. But natural selection, as Darwin also often said, cannot originate anything. It can only develop characters which are transmitted, and if habits—which are only mental variations—were not transmitted, natural selection could not develop them. These mental variations must have been transmitted by some physical process from the brain to the germ-cells, and adaptations of all kinds must in like manner have been transmitted, or there would have been no progress in the animal and vegetable kingdoms.

For instincts in animals must have been acquired either by inheritance or by imitation, and we have only to select instances where imitation is impossible to prove that instincts are inherited. For example, when a newly born baby cries, it is not imitating anyone in the room. It is repeating what its father and mother did in similar circumstances. It is the same with breathing. This must have commenced as a semi-conscious act which quickly passed into a habit and then became instinctive. When the crying of babies first began I do not know, but breathing has been instinctive ever since the Carboniferous period. Millions of generations, one after the other, have performed the operation, and it is now out of our power to stop it. Again, young fish never see their parents, yet they follow their habits, as also do young cuckoos and many insects. But I need not multiply examples; these are sufficient to prove that instincts are transmitted. If instincts are transmitted it must be through physical modifications made in the brain, and if this is the case there can be no doubt but that other physical modifications, not in the brain, can be transmitted also.

Prof. Hering says that the nervous system, which collects impressions from all parts of the body and transmits them to the brain, transmits them also to the germ-cells. But in plants and in animals without a nervous system the protoplasm itself must do the work, and it is therefore possible that the nervous system may not be used for this purpose in the higher animals. This is a question for future biologists to solve. But whatever the explanation may be, we must recognise as a fact that variations in external characters influence the germ-cells, and that the germ-cells reproduce these variations. If we call the analogous process in the brain memory, we must either apply the same term to the process in the germ or invent a new one.

Now we come to the last great difficulty, that of believing mind and memory to exist in the tissues of animals and plants. The best way of examining this difficulty is to ask ourselves What we mean by life? and How we recognise living matter?

As everyone knows, we recognise its presence by certain movements which are distinguished, without much difficulty, from movements due solely to physical energy. A bird flying through the air is alive, as also is a seed if, when placed under certain conditions, it commences to grow. Assimilation, or feeding, is the basis of all these movements. It supplies the materials for growth and the energy necessary for the movements.

This process of assimilation is only found in protoplasm,

but it is not an essential property of that substance. We have dead protoplasm which has been killed by heat or starvation, by poison or by violence of some kind. These agencies, however, may cause disorganisation either in the structure or in the composition of the protoplasm, so that protoplasm so killed ought possibly to have another name. But this does not apply to all cases. When the oöspore of some of the lower plants—such as Chara—begins to germinate, the contents divide into two portions of unequal size, and while the smaller cell goes on developing the larger one never again moves, but its contents are gradually absorbed by the smaller cell. The larger cell of the two contains only dead protoplasm which has been separated from the living substance by the process of cell-division. Each contains part of the old nuclear plasm and part of the cytoplasm, and it is not supposed that they differ either in structure or in composition. It is the same with the polar bodies which are extruded by reproductive cells when they are maturing. They also are composed of dead protoplasm which has been pushed out by the living protoplasm remaining in the cell. The polar bodies cannot move by themselves, nor can they assimilate; they are dead protoplasm. Consequently we must assume that life is an adjunct and not a necessary quality of protoplasm.

Neither are the movements themselves life. When we speak about gravitation we do not mean the fall of bodies to the earth, nor do we call the movements of the mariner's compass magnetism. In both cases it is the *cause* of the movements which we designate as gravitation or magnetism, and it is the same with life. Now what do we know about the cause of these movements?

In the higher animals we recognise that vital movements are due to mind, that is, to intelligent action, where means are adapted to a definite purpose. We can only recognise mental action in others by the movements it produces, and it is by the nature of these movements that we judge of its presence. One great characteristic of mental action is cooperation, by means of which work is done which could not be accomplished by isolated action. This gives rise to harmonised movements either of different parts of the body or of different individuals.

Another characteristic of mental action is that it is capable of improvement by repetition. This is due to memory, which, by repetition, converts the irresolute movements, which are undertaken for the first time, into automatic or resolute movements. These automatic or reflex actions we recognise by their indefinite relation to the stimulus. The same stimulus may produce different effects in different parts of the body, or different stimuli may produce the same effect upon the same part of the body. Again, by constant repetition a stimulus may either fail to produce any effect owing to the protoplasm having got accustomed to it, or repetition may intensify the first effect. This is very different from the action of the physical and chemical forces, which act as resolutely the first time as afterwards; yet we sometimes see it stated that reflex action is purely mechanical, and that it is a proof that living matter is as much under the influence of fixed laws as is inert matter. A little consideration, however, will show us that such is not the case, for if reflexes were mechanical actions they would act with as much certainty the first time as the last. But it is not so. The truth is that in the higher animals when a new stimulus arrives at the brain it is examined by the mind and certain action is taken. When the same stimulus arrives a second time, the mind comes to a decision more quickly, and constant repetition makes the brain act unconsciously. Also reflexes are not immutable. The degree of difficulty in changing them depends upon the number of repetitions to which they have been subject. A habit may be formed and become reflex, but we can generally alter the habit if we try. Even the instincts of insects are not altogether unchangeable, and we occasionally see reason come in and alter them. It is only very old instincts, like breathing or the beating of the heart, which are quite fixed. This, again, is very different from physical law. Reflex action is only pseudo-mechanical. It is law which mind has imposed upon itself to save itself from trouble, and if the action has not gone on too long it can be varied. This, indeed, constitutes the difference between physics and physiology. In physics we have to do with fixed law only, but in physiology we find both law and custom.

Much interest has lately been aroused by the demonstration that in the ova of some animals the centrosomes can be produced and development started by the action of certain reagents, such as magnesium chloride, and this has been taken as a proof that physical can be changed into physiological energy. But the chemical reagents cannot form the centrosomes; the materials must be there and the stimulus merely starts them into action. The protoplasm of the ovum, on being stimulated, whether by the natural stimulus of fertilisation or by an artificial one, sets to work in the only way it knows, that is, by preparing for the process of mitosis. This, and the growth of the pollen-tube when stimulated by an application of sugar, are merely cases of reflex action.

These unconscious movements often have a harmonised action, as if they had originally been intelligent, and in the higher animals we rarely have any difficulty in distinguishing movements due to mind from those due to the physical energies.

In the lower animals and plants the action of conscious mind is not evident; but we recognise the presence of life by movements which correspond closely with those due to unconscious mind in the higher animals, that is, we can recognise harmonised action and changeability.

First we have movements which are called spontaneous, that is, they are not directly connected with external causes. These may be voluntary, that is, due to the will, or reflex, that is, are performed unconsciously on the application of a stimulus. What is called irritability in protoplasm is merely reflex action, and if reflexes are due to experience they imply the presence of both mind and memory.

Secondly we have, in all living protoplasm, the phenomena of growth and reproduction. Growth by assimilation is considered to be an attribute of living matter, because it is a process which, at present, cannot be imitated by chemists. But increase in size also takes place in minerals, and it is the characteristic direction of growth to which assimilation gives rise by which we recognise living substance. This direction of growth undergoes gradual changes, but new variations are inconstant; they may not be repeated, or only partly repeated. But if they are repeated, then they become constant, and will remain so for many generations, notwithstanding varying external conditions.

Now it will be noticed that these characteristics of living matter are practically the same as the characteristics of mental action in the higher animals. We have changeableness, learning by experience, cooperation and harmonised action, and we cannot help associating life with mind. Not only is it true that where there is mind there is life, but the converse is also true, where there is life there is mind. Mind seems to be the cause of the movements by which we recognise living substance. It is the "vital principle" of some physiologists. Life has no entity of its own; what we call by that name is the movements of protoplasm under the direction of mind. Or life may be said to be mind made manifest to us by the movements of protoplasm. Or life is a special kind of motion caused by the action of mind on the molecules of protoplasm, the characteristics of which are spontaneity and adjustment. This mental action is active and often conscious in the higher animals, sluggish and subconscious in the lower animals, and passive in plants, but it is there in all.

Thus we have come by a different line of argument to the same conclusion as that of Prof. Hering, namely, that mind exists in all living cells, and where there is mind we must suppose that there is the capacity for memory also. Thus we see that biology is a branch of psychology. It is the study of the growth and development of protoplasm under the influence of mind, and this influence ought never to be forgotten when studying the fundamental problems of biology.

But this is not all, for, if the theory be true, it necessarily follows that mind must be, to some extent, a free agent capable of controlling the physical energies. For if it were not so it could not superintend the process of assimilation, neither could it defend protoplasm from the action of external agencies. Mind is only subject to those laws

which it has imposed upon itself. However much we may marvel, we must allow that this is a fact of experience, and as inductive science is founded on all the facts that can be obtained, the spontaneous movement of living protoplasm can no more be omitted than the absence of initiative in non-living matter. So that, although we cannot explain how mind influences protoplasm, we must acknowledge that it does do so. Variations may depend upon the amount of stimulus received by the mother cell, and they may be developed automatically by selection, but neither selection nor stimulus can originate new processes or new structures. It is impossible to suppose that the external physical agencies, when they act upon protoplasm, antagonise their actions by forming chemical or physical combinations, for this is so different from what happens with dead matter. Dead protoplasm can no longer resist the attacks of other organisms, and it is only by undergoing the process of assimilation that it can be revivified. If there is any truth in Mr. Herbert Spencer's definition of our conception of life as the continuous adjustment of internal to external relations, it follows that living protoplasm must be free to adjust itself. But whether these adjustments were intelligent and purposive or whether they were due to haphazard gropings after change is a separate problem which still requires solution. All that we can say at present is that while dead matter is subject altogether to fixed laws, living protoplasm is, to a certain extent, free to act. To it has been given the power of adaptation or antagonism to the physical laws which the rest of nature obeys implicitly. Ever since living matter appeared on the earth a constant war has been waged between dead and living matter, and mind has won, the result being biological evolution. Chemical affinity has been taken advantage of by mind to protect itself from enemies. Physical energy has been used to break down chemical affinity, and then mind has been able to lay up a store of potential energy. But it has overcome the physicochemical laws only by obeying them, and this has given rise to the illusion that it is not free but subject to fixed law, like dead matter. This, however, cannot be the case. At first mind was free to act, but constant repetition of the same experiences made it an apparent slave to the physical forces, although when attention was occasionally called into action by new external irritants it again reasserted itself. But this was followed by relapse. The cooperation and concentration of nervous matter, however, still went on until, in the brain-cortex, attention developed into consciousness, and in the large cerebrum of man, mind has once more passed into its original free state. It is this form of volition that we call free-will.

Such I believe to be the full scope of Prof. Hering's theory. I must confess that I have gone beyond his address, and I do not know that he would agree to all that I have said. But it is evident that we must either assume a freely acting mind as the mainspring of organic development, or we must try to explain it on a purely mechanical basis, a task which appears to me to be quite hopeless.

F. W. HUTTON.

Canterbury Museum, Christchurch, New Zealand.

Curious Shadow Effects.

I THINK that the following is probably the explanation of the phenomenon referred to in NATURE of February 4—the seeing of more shadows than your own.

A and B are neighbouring observers; their shadows make dark tunnels in the illuminated mist.

Usually, the eye cannot penetrate far, and if A is to see his neighbour's shadow he has to look *across* it, as along ACD, and the layer CD is too thin to be noticeable. Or, if he can see further, as along AEF, the glare of the illuminated mist between A and E may prevent him from noticing the thicker dark layer EF. He sees his own shadow because he looks more or less *along* it. But under suitable conditions his eye may be able to penetrate so far that he can see the thicker layer EF of his neighbour's shadow, while yet there is not much glare near at hand, *i.e.* in the part AE, to dazzle him; the mist in this region may be very thin. [The diagram does not represent clearly the way in which the shadows "tail off" and vanish at a certain distance owing to the finite angular magnitude of the sun.]

If the angle GAE be not too great, A will see B's shadow within his own halo.

This halo I have always taken to be the ordinary rainbow. It may look small, but the true criterion is its angular

magnitude. This would not, however, explain the oval bow spoken of in NATURE, January 28.

W. LARDEN.

Devonport, February 5.

IT is obvious that the bow seen by Mr. Warner and described in NATURE of January 28 (p. 296) was the "Ulloa's ring," the "Nebelbild" or "Brockengespenst" of the Germans, fully explained by Fraunhofer. The oval form is a necessary consequence of our seeing the sky as a depressed vault or segment of a hollow sphere, as I have demonstrated it in my "Meteorologische Optik," I. Abschnitt, p. 29 *ff.*; see especially p. 33, Fig 5.

I beg to answer also Mr. John A. Harvie Brown's question on shadows in the "Brocken," asked in your issue of February 4. He says:—"How was it that more than one image was visible to each of our party?" Mr. Harvie Brown states that "not one of us saw more than one set of concentric rainbow bands or circles." The answer seems to be simple. The shadows are objective, and therefore visible to everyone; the coloured circles are only subjective, and consequently one person sees only one set of rings. I know that in text-books one reads the statement, "the observer of a 'Brocken' cannot see his companion's shadow," as, for example, in Müller's "Kosmische Physik" (even in the edition of 1894), but this is evidently erroneous.

Wien, Hohe Warte.

J. M. PERNTER.

THE staff of the Ben Nevis Observatory have had frequent opportunities of observing the coloured shadows formed round shadows thrown on mist or fog-banks; notes descriptive of these "glories," as we termed them, with measurements of their diameter, will be found in the extracts from the log-book printed with the other Ben Nevis observations (see *Transactions* Royal Society Edinburgh, vols. xxxiv. and xlii.). In each ring of these glories the red of the spectrum colours was outside and the blue inside, as in the primary rainbow, and as many as five successive rings of colours have been observed.

The outside diameter of the largest ring never exceeded 12°, and was more usually about half that amount. Glories are thus of the same order of size as the coronæ frequently seen round the sun or moon, and are distinctly smaller than halos, the ordinary halo having a diameter of about 44° (radius 22°), while rainbows and fog-bows are, of course, larger still.

In respect to Mr. Warner's letter, I may say that no oval-shaped glories have been seen on Ben Nevis, but other observers have described them, and a possible explanation may be that a circular ring is formed on a surface at right angles to the sun's rays, but the observer assumes that the ring is formed on a vertical surface, and therefore it appears oval to him. However, the low angle of the sun's rays at Christmas time does not differ sufficiently from the horizontal to cause in this way the elongated oval shown in Mr. Warner's sketch; there must be other factors to consider.

With regard to the shadows of other persons, our experience on Ben Nevis was that if the fog-bank was a considerable distance away, the shadows of others could be seen just as on a wall; but if the fog was close to the observers, the only shadow seen resembling a human figure was one's own. Sometimes, however, when a thin fog was close to us on one side, and bright sunshine on the other, I have seen the shadow of a man standing 10 or 20 yards away as a dim dark streak running back into the fog. The shadow, in fact, was not formed on any definite surface, but was a

shading of the drops forming the fog throughout a considerable distance. Each person looking at his own shadow sees this shading end on, but he can get only a side view of his neighbour's shadow when the fog is near. When the fog-bank is far away compared with the distance between two spectators, each is looking at both shadows practically end on, and both are easily seen.

Edinburgh, February 6. R. T. Omond.

Corrections in Nomenclature: Ca'ing Whale.

Ca'. It's unco silly—the neighbours ca' me a Jacobite = *call*.

Ca'. And the young lads hae na wit to *ca'* the cat frae the cream = *drive* (*v.* "Encyclop. Dictionary").

J. A. Harvie Brown.

THE CENTENARY OF KANT.

A HUNDRED years have now passed since the death of Kant. On February 12 the great philosopher died at Königsberg, in East Prussia, where he spent practically his whole life, a long, laborious and ascetic one, in the single-minded and ardent service of science. That his teaching created a remarkable epoch in the history of thought, an epoch, indeed, to which we refer and by which we estimate, of necessity, all subsequent developments, will not be disputed, and so important a centenary has naturally claimed the attention of the whole cultivated world. Immanuel Kant is so much akin to some of our English writers, notably Locke and Hume—was it not Hume who, in his own words, "aroused him from his dogmatic slumbers" and, moreover, does he not himself tell us of his Scottish ancestry?—and in some respects was so much influenced by them, that England may well join with Germany in paying a tribute of reverence to his memory. Kant literature is so voluminous already, and the story of his life, so far as he had a life apart from his work, has been so well told, that little remains to be said beyond a brief reference to his intellectual affinities and to the relationship of his critical philosophy to the existing world of physical science, to compare, in other words, the *a priori* and ideal with the naturalist and *a posteriori* results. An antithesis between these two halves of thought has ever been a prominent feature in our efforts after knowledge, though of late it has grown to be regarded as a convenience in classification rather than an absolute distinction. For many of us the policeman still acts as the representative of ethics, and we are seldom transcendental except in personal instincts. It is also incontestable that

> "Until this paragon of spheres
> By philosophic thought coheres,
> The vast machine will be controlled
> By love and hunger as of old."

But in rational development nothing pleads more urgently for reconciliation in the future than these two great currents of human activity, one of which owes so much to the genius of Kant and the other to the indefatigable energy of recent research.

So many and so varied workers have been animated by the spirit of Kant, conscious or unconscious of their debt, that there is a danger of overlooking the strength of his influence. Most can raise the flower now, all have got the seed, and even such dissimilar minds as Hegel, Schopenhauer and von Hartmann are truly consequent on Kant. A whole army is the better equipped for the "celestial panoply" of that solitary epoch-maker, lifted above the merely objective events of his age to his *bestirnte Himmel* by a torrent of thought setting inwards, centripetal rather than centrifugal. So fine a mind, frailly supported by a delicate physique yet disciplined to a rigorous austerity in matter and spirit, was surely destined to fame. The philosophic habit cannot be put on like a garment. It is all or nothing. To be influenced at all is to be responsive in every fibre; and with Kant the relation of the mind to its world was the San Graal of his quest—his religion. It was for him, too, its own reward, and almost the sole one, though in time he gained more of contemporary fame than comes to some of the great ones of the earth. For, as Spinosa says so deeply, "He who loves God truly must not look to be loved by Him in return."

It is interesting to note that the manner of Kant's intellectual development, as instanced in the chronological record of his works, is from the simpler to the more complex, from the physical to the psychical. It may be pointed out in this connection how solid was the foundation of empirical knowledge upon which he based his epistemology, and this is surely the *sichere Gang der Wissenschaft*. In this long period of apprenticeship we may trace the workings of that marvellous intuitive faculty which he employed in the more abstract realms. His treatises on physical subjects traverse a wide range. In "Thoughts on the True Estimate of *Vis Viva*" he shows the Cartesians and Leibnitzians to be fighting about different things. The dispute was due to incorrectness of definition as to the meaning of force, but it is only fair to say that Kant's views, unknown to him, had been anticipated. In another essay he affirms that the earth's rotation is slowly retarded by the action of the tides. But the "General History and Theory of the Heavens" of 1755 was a more ambitious work. He was then aged thirty-one, and at the height of his speculative power; extending the cosmographical conceptions of Newton to the whole phenomenal cosmos, he introduces for the first time the conceptions of the nebular theory. Though worked out more fully in its details by Laplace at a later date, this soul-stirring thought owes its essential origin to Kant, and may well be associated with his name rather than with that of the great Frenchman. This efflorescence of Kant's comprehensive outlook has been the greatest triumph of cosmography since the publication, some two hundred years earlier, of the "De Revolutionibus Orbium Cælestium." And in his later work Kant was another and no less influential Copernicus who showed how the planet feelings circle round the constructive and illuminating mind, where erstwhile that sun of reason had been held the satellite. He too divined that Nature, in its silent unplumbed depths of space and mind, holds more than earth and man.

The growth of the body of knowledge since the death of that old man in Königsberg may be held to show more of bulk than of differentiation. Yet when we look to the fact that he forged a weapon of research, ready to the hand of all, rather than spend his labour within the meshes of a system such as those woven by Comte and Spencer, we find cause for saying that Chronos does not always devour his own children. We are all thinkers, on our several planes, and the struggle for existence forces us to acute thinking at times, but we commonly fail to shut out the seeming discord between speculative ideals and experience. The pressure of that "unconscious" which according to von Hartmann moulds our lives may seem the agent in advance of materialism, though the moral sphere is not yet wholly at its mercy. The universal practical acquiescence in the dogmas of conduct still silences theoretical doubt. In spite of the gigantic accumulation of scientific facts, no Œdipus has yet returned an answer more permanently satisfying than that which was given by Kant to the central question of the sphinx of life, as to the conditions of all and any

knowledge and of the meaning of personal identity, which must always most strenuously exercise our highest faculties. If there has been any marked shifting of ground, it has been towards the region of personal experience, a return to the principle of *cogito, ergo sum*, a principle of more metaphysical treasure than Descartes himself discovered. The living and dynamic nature of the self has come to stand out in more striking relief. The self-realisation of Hegel and the will of Schopenhauer, ideas so typical of the resolute individual character of western ethics, will illustrate one of the many lines along which Kant's impulse has acted. In nothing is he more emphatic than in urging the necessity of a critical inquiry into the foundations of knowledge before attempting to deal with the opposing dogmatisms of physics and metaphysics, and it is just the validity of his own *Kritik* which has made the later times so productive of reconstructions. The parts in our vast system of knowledge have at the same time become more and more related to an organic whole. More and more has the analogy of the living organism, with its parts in the whole and its whole in the parts, become descriptive of the body corporate of thought, and it may perhaps be said that it enters into our conceptions of the whole of being. Perhaps the full result of this idea in its religious aspect has not yet been realised. Certainly the living purpose of the abstract physical law has not yet been successfully formulated either by transcendentalist or materialist. ALFRED EARL.

THE FORMATION OF CORAL REEFS.

CORAL reefs are divided into three classes, fringing, barrier and atoll. A fringing reef forms a terrace at the low tide level, extending out from the coast of any land, while a barrier reef is a rampart at the same level, lying parallel to the coast, from which it is separated by a deep channel. An atoll is a ring-shaped reef surrounding the lagoon, a basin varying up to 50 fathoms in depth; it is thus in no way connected with any land other than may form upon it.

A typical atoll has a flat encircling reef, generally with a series of islands upon it and a number of channels leading into its lagoon. Where land exists, the reef may be a mile or more broad, but commonly averages about 500 yards. Its surface is a flat of coral limestone almost completely bare of sedentary life. Towards the ocean its edge appears as if the waves were cutting a series of canals into it, but this appearance is really due to buttresses being built out from the rock behind by the reef organisms. Beyond this edge the bottom is extremely rough, but passes gradually into a more even slope. This area, the *reef platform*, may have hollows and pockets filled with débris, but its prevailing characteristic is its almost complete covering of corals, nullipores, Foraminifera, Polyzoa, and other sedentary organisms. At about 250 yards from the edge of the reef, where its depth is about 40 fathoms, it passes somewhat abruptly into a *steep* at a slope often exceeding 50°. This continues to about 140 fathoms, after which the slope, becoming quite moderate, passes gradually into the contour of the surrounding sea. The steep has never been properly investigated, but swabs bring up loose dead masses of such organisms as cover the reef platform above. Their presence is due to the undercurrents resulting from the sea striking on the atoll, which sweep down the reef platform, giving a talus slope (Fig. 3). Again, we have little knowledge of the lower slope down to 500 fathoms, where deep-sea life probably dominates. Shoals at such depths are densely covered with corals, but off atolls the lead only occasionally brings up a cup. Probably sedentary life is far from scarce, as the fine coral mud, so deleterious to coral life, appears to be swept further out.

Lagoons vary greatly in accordance with their size and depth. A fairly open one has its bottom above the 25 fathom line either bare or covered with coarse sand, but deeper a fine mud may be found. Commonly the depth of any deep lagoon bears some proportion to the depths of the passages into it. Shoals occur anywhere in it, reaching the surface and forming broad flats. From the lagoon floor they arise abruptly, as does also the encircling reef (Fig. 3), a gradual slope to 20 fathoms or less covered with decaying coral masses, and then a perpendicular cliff to the surface.

The examination of the surface of the encircling reef shows it to have been formed by corals, bound together by other organisms. These corals form a definite class not extending below 25 fathoms in any luxuriance. They feed mainly—and many entirely—by their commensal algæ, so that they, as also the nullipores, are dependent for their growth on light and constant change of the water. They are profoundly affected by any deposition of mud, and for this reason upgrowing shoals are rare in lagoons except near passages. The enormous amount of mud formed is shown by its sinking as a deposit around atolls. The muddy water that streams out of the lagoons in stormy weather shows where it originates; but little can come from the surface of the reef, which is stationary in height, and still less from the reef platform, covered as it is by the bodies of living organisms. It is the result of the action of the boring and sand-feeding animals of the lagoons breaking up the coral skeletons and grinding them into the finest mud, much of which passes into suspension in the water. The corals on any low part of the encircling reef over which the lagoon water may pour are killed by this mud, leaving bare areas for the entrance of boring organisms, with the result that a new passage may be cut through the rim into the lagoon. That solution is also of great importance in the lagoons seems certain, for the mud at the bottom of such a lagoon as Suvadiva contains more than 2 per cent. of silica, whereas the sand of the reef has less than 0.04 per cent.

At 40 fathoms different genera of corals, not dependent on commensal algæ, dominate, and at the edge of the reef platform are the builders, their mortar consisting mainly of the encrusting Polytrema. They range from the surface, where they are almost choked out by others to 50 fathoms or more, and probably form an important connecting link between the surface builders and the true deep-sea corals, which in the tropics are seldom found above this latter depth. Their rate of growth, and also that of the surface forms, is enormous. Indeed, it would be moderate to estimate that a shoal at 25 fathoms would be built up to the surface in 1000 years, and that one at 50 fathoms would scarcely take more than twice as long.

Recent work has shown that all coral reefs can scarcely be explained on one method of formation. Four modes naturally suggest themselves.[1] (1) (Fig. 1) On any elevation on the bottom of the ocean sedentary animals naturally congregate. Their remains build up its summit to an extent out of all proportion to the upgrowth of the surrounding area, so that it ultimately approaches the surface. The deep-sea corals in warm latitudes give place to their intermediate depth allies, and these again to the reef builders, so that our peak is ultimately crowned with a surface reef. It will be readily understood from the

[1] A fuller consideration of some of the views here put forward will be found in "The Fauna and Geography of the Maldive and Laccadive Archipelagoes," pp. 12–50, 146–183, 313–346 and 376–423.

description above of a typical atoll that such a reef extends outwards on its own talus to form a great broad plateau. Boring organisms enter on its central part and cause the rock to decay. Sand-feeders follow

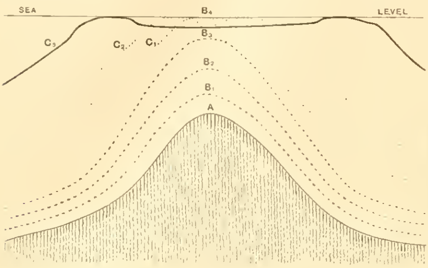


FIG. 1.—Diagram to illustrate the first method of formation of an atoll. A, Original mound on the sea floor. B 1–4, Growth of the same to form a surface reef. C 1–3, Extension outwards and formation of an atoll.

and triturate up the fragments, throwing a constant stream of fine mud into suspension in the water to be removed by the tidal and other currents. Assisted by the solubility of coral in sea-water, a lagoon is formed in the centre of the reef, and passages are cut later from it along the lines by which its muddy water escapes. The process may continue to form an atoll of the largest size, such even as Funafuti or any of the Ellice and Gilbert groups, which appear to have arisen on a single mountain range.

(2) (Figs. 2 and 3) The second method of formation depends on the power of the ocean currents to cut down land and form submarine banks. It is exemplified by the Maldive Group, the main chain of which is more than 300 miles long, and lies at right angles to the monsoon currents of the Indian Ocean. Here the action of the currents appears to have cut down a great tract of land, or at least a series of peaks, to form a plateau more than 100 fathoms in depth (Fig. 3). It is easy to see how the loose mass of cinders formed in a submarine eruption might be so cut down to 30 or even 50 fathoms, but this action, when first proposed for the Maldives, seemed extreme. It has, however, received strong support from the work of the Siboga Expedition in the East Indies. At depths below 50 fathoms it is obvious that from the first the organisms on the periphery of the bank so formed would grow up more rapidly, and so an atoll as such would directly arise (Fig. 2). The whole action might proceed extremely rapidly. Indeed, it is not unlikely that the shoal marking the site of what was once

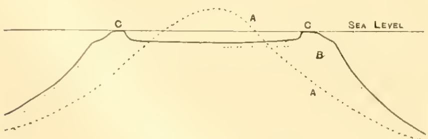


FIG. 2.—Diagram of the second method of formation of an atoll. A, Contour of the original island. B, The same cut down to form a plateau C, The atoll reef.

Falcon Island, Tonga, will by 4000 A.D. be occupied by a considerable atoll. The action on a land like the Maldives, which is of considerable linear extent and of more solid construction, would proceed more slowly and show many modifications. A certain number of channels would be retained and even deepened as the rim grew up. Each piece of rim as it formed would give a protected area behind itself around which the currents would sweep, and might thus become separated as a distinct bank or atoll. The same action might occur at two or three levels, and in this way the whole bank, instead of being crowned by one atoll ring, might be surrounded by a series of secondary atolls, their rims again formed by series of still smaller tertiary rings. This, in truth, appears to be the case in the Maldives, but the continued upgrowth of the rims of the secondary atolls is uniting the outer sides of the

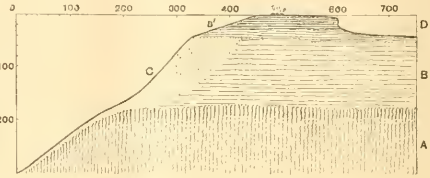


FIG. 3.—Section of the outer edge of one of the Maldive atolls. A, Foundation of primitive rock cut down by the currents. B B', Upgrowth of the rim by the deep-sea, intermediate depth and reef organisms. C. Extension outwards by means of the talus slope. D, Lagoon. (*Scale in fathoms.*)

tertiary rings, while their inner parts are being removed.

(3) (Fig. 4) A flat terrace is formed around the shore of an island by the action of the sea on the land, and is covered at its edge by reef organisms, or a fringing reef is formed. Subsequently, the edge of the terrace grows outwards and its inner part is removed as in (1), forming a barrier reef. Eventually, the original island, owing to similar causes, disappears, leaving an atoll. This method is of quite wide occurrence in

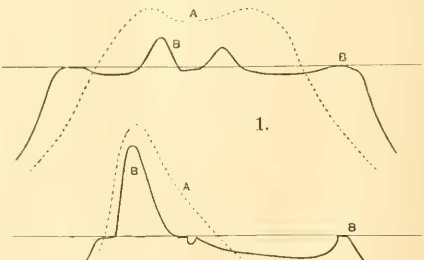


FIG. 4.—Sections across (1) Ongea Levu, Fiji, limestone, and (2) Wakaya, Fiji, volcanic, to illustrate the third method of formation. A, Supposed contour of the original land. BB, Section across the existing land and reef. (*Vertical scale many times the horizontal.*)

areas where elevated coral reefs are found (Fig. 4, 1). Every stage can be followed in the limestone islands of the Fiji group. It also occurs, though much more slowly, around other islands. A good example is Wakaya, Fiji, which has to the west a broad fringing reef, half formed by a terrace cut out of the land and half by a true coral formation, and to the east a barrier reef separated by a channel $3\frac{1}{2}$ miles from the land, which still retains a definite terrace of the volcanic rock (Fig. 4, 2).

(4) Lastly, the subsidence of land might give a suitable foundation on which a reef could *build up to the surface* either as an atoll or subsequently to form one. It has no doubt constantly produced large areas where (1) and (2) could act, but, where it has directly brought about the formation of atolls, it has probably been a purely local phenomenon. In no case can the mere existence of any atoll or reef be considered as evidence of any subsidence. Certain elevated reefs appear possibly to have owed their origin to this mode of formation, but there is no definite evidence in support of it for any existing reef, though certain reefs in the East Indies and to the south-west of the Indian Ocean may have so originated.

The first three modes of formation resemble one another in that to produce the characteristic forms of reefs they depend on factors which can be clearly seen in progress at the present day. Indeed, on each atoll may be found the same influences at work as produced its structure and appearance. The topography of the numerous submerged tropical banks of the Indo-Pacific region, that reach within 50 fathoms of the surface, strongly supports (1) and (2), but the examination of others at greater depths, such as the Saya de Malha and Nazareth, is exceedingly desirable. More light, too, is imperatively demanded on the conditions and life of atoll slopes and shoals from 50 to 500 fathoms, where the characteristic deep-sea conditions would seem to prevail. The study of the fauna also down to these depths over any large region or ocean may confidently be expected to throw a flood of light on the distribution of marine forms, and thus enable us to predict with some additional degree of certainty the former distribution of land and sea.

J. STANLEY GARDINER.

PHOTO-TELEPHONY.

THE transmission of speech by light was first realised nearly a quarter of a century ago by the invention of Prof. Graham Bell's photophone, a full description of which will be found in NATURE, vol. xxiii. p. 15. The transmitting instrument contained a small silvered disc or diaphragm of thin microscope cover-glass, which was clamped around the circumference like the diaphragm of a telephone. The receiver was a large parabolic mirror, at the focus of which was fixed a selenium cell in circuit with a telephone and battery. A beam of light from the sun or an electric lamp was reflected by the silvered diaphragm to the parabolic mirror, which concentrated the rays upon the selenium cell. The speaker's voice was directed upon the back of the diaphragm, causing it to vibrate in correspondence with the sound waves; the rapid changes in the curvature of its surface which accompanied the to and fro movements of the central parts of the diaphragm varied the concentration of the light upon the selenium, and since the conductivity of the selenium varied with the illumination, sounds were produced in the telephone similar to those by which the transmitting diaphragm was agitated.

Though the performance of the photophone was for short distances surprisingly perfect, it failed for several reasons to give satisfactory results when the transmitter and the receiver were separated by more than two or three hundred yards, and for a long time all attempts to render the invention practically useful were abandoned. The resuscitation of the photophone in a modified form has resulted from the recent discovery of the "speaking arc."

A few years ago Dr. H. T. Simon, of Göttingen, having noticed the curious sounds given out by an arc lamp when one of its leads happened to be near a wire supplying intermittent currents to an induction coil, was led to try the effect of superposing a microphone current upon the current feeding the lamp. With this object he interposed the secondary coil of a suitable transformer into one of the lamp leads, while the primary coil was connected in circuit with a battery of two or three cells and an ordinary microphone, the latter being placed in a distant room. Words spoken into the microphone were distinctly repeated by the arc, which was found to constitute an excellent telephone receiver. The simple arrangement originally employed by Dr. Simon has since been modified in some details, notably by Mr. W. Duddell, who in 1900 caused an arc lamp to address a large audience in the hall of the Institution of Civil Engineers.[1] That such an effect should be produced by so small a cause as the feeble induced microphonic currents is surprising; Mr. Duddell has, however, shown experimentally that a periodic variation of the order of 1 part in 10,000 of the mean current supplying the arc will alter the vapour column sufficiently to produce sound-waves.

No change of luminosity while the arc is talking can be recognised by the eye, but if the light is caused to pass through a transverse slit upon a moving kinematograph film the developed negative shows a succession of narrow bands of varying brightness, indicating that considerable changes actually do occur in the intensity of the light.

Prof. Graham Bell suggested in 1899 that the speaking arc might be used as transmitter in phonographic work. His suggestion has been followed up with conspicuous success by Dr. Simon himself and by Mr. Ernst Ruhmer, of Berlin, the latter having been able to transmit intelligible speech across distances up to 15 kilometres. As a transmitter he uses a search-light projector having a parabolic mirror of silvered glass at the focus of which is the speaking arc; the carbons are placed horizontally along the axis of the mirror with the positive carbon outwards. A small telescope serving as a finder may conveniently be attached to the projector. The light is received, as in the older apparatus, by another parabolic reflector having a cylindrical selenium cell fixed axially at its focus. It is chiefly to the peculiar quality of his selenium cells that Mr. Ruhmer attributes the excellence of his results. The cells are of a pattern proposed by the present writer in 1880 (NATURE, vol. xxiii. p. 59). Two thin wires serving as electrodes are wound spirally, very close together but not touching, around a cylinder of unglazed porcelain, upon which a fine double screw-thread (to receive the wires) has been formed before baking. The surface of the cylinder is covered with a thin coating of selenium, which is afterwards crystallised; thus the two wire electrodes are joined throughout their length by the sensitive substance. Great importance is attached to the mode in which the crystallisation is effected. Vitreous selenium may be crystallised either, as is usually done, by gradually heating it up to a temperature somewhat above 100° C. or by melting it at a high temperature—about 250°—and letting it gradually cool down. In the latter case the crystalline surface appears to be of a coarsely granular structure, and it has long been known to the writer that selenium thus prepared is much less affected, as regards conductivity, by changes from darkness to light than the fine-grained variety obtained by the other process. This is confirmed by Mr. Ruhmer, but he has added the further interesting observation that the coarse-grained kind—"soft" selenium he calls it—is immensely more sensitive than the other, or "hard" selenium, to *small* changes of illumination, and, moreover, that it re-

[1] A detailed description of his apparatus is given in *Journ.* Inst. Electrical Engineers, vol. xxx. p. 240.

sponds to such changes far more quickly. Hence it is particularly well suited for use in a photophonic receiver. It is found advantageous to enclose the selenium cell in an exhausted glass bulb, like that of an ordinary glow lamp.

In order that the apparatus may be serviceable when the atmosphere is too misty, or the distance too great, to admit of the transmission of speech, Mr. Ruhmer has provided an arrangement for telegraphing audible Morse signals to the receiving station. The microphone is taken out of the circuit, and an automatic current interrupter, or "buzzer," inserted in its place. When this is operating, the arc emits a loud continuous note, which can be broken up into periods corresponding to dots and dashes by a simple key in the primary circuit. Such signals are plainly heard in the receiving telephone when speech would be inaudible, and the device is superior to the heliograph in that the signals may be made more rapidly, and cannot possibly be detected by parties for whom they are not intended.

It is said that the whole of the apparatus here described is now being manufactured commercially by a leading firm in Germany.

SHELFORD BIDWELL.

NOTES.

THE centenary of the death of Immanuel Kant was celebrated on February 12 by the University and the town of Königsberg, in the presence of the Prussian Minister of Education, Dr. Studt, and various representatives of German academic corporations. A short article inspired by the occasion appears elsewhere in this issue. The proceedings began, says the Berlin correspondent of the *Times*, with the unveiling of a memorial tablet by Dr. Studt, who delivered a message from the Emperor William, and referred in the course of an address to the services which Kant had rendered to learning and to the world. The Minister further announced that he had assigned a sum equal to 500*l*. from the public resources at his disposal in support of the teachers' aid fund. The town of Königsberg has devoted a similar sum to the foundation of an annual prize for essays on philosophical subjects. On the memorial tablet which was unveiled on the wall of the Royal Castle in the Kantstrasse is inscribed the well-known saying of Kant:—"The starry sky above me, and the moral law within me." In commemoration of this anniversary a special meeting of the British Academy was held on Friday, and a paper upon Kant's work and influence was read by Dr. Shadworth Hodgson.

SOME considerable rearrangements have been made in the museums at the Royal Botanic Gardens, Kew. A new gallery 130 feet long by 16 feet wide at the back of museum No. iii. was opened on February 1. To this the entire collection of Gymnosperms (Conifers, Cycads and Gnetaceæ, including Welwitschia) has been transferred. The space in museum No. i. thus set free has been utilised in making a more effective display of its contents, which had become very crowded. The well-lighted wall-space in the new gallery has enabled the collection of maps and plans of the establishment at various periods to be brought together. Several of these have been contributed by H.M. the late Queen and by H.M.'s Office of Works, and are of considerable historical interest. A set of the fine photographs of Kew in its various aspects which were sent by the Government to the Paris Exhibition of 1900 are also shown, as well as an extensive series of photographs of coniferous trees in their native countries.

THE eighth International Geographical Congress, which will meet at Washington, D.C., in September next, will be the first international meeting of geographers in the western hemisphere. The congress will convene in Washington on Thursday, September 8, in the new home of the National Geographic Society, and will hold sessions on September 9 and 10, the latter under the auspices of the Geographic Society of Baltimore. Leaving Washington on September 12, the members, associates and guests of the congress will be entertained during that day by the Geographical Society of Philadelphia, and on September 13, 14 and 15 by the American Geographical Society in New York, where scientific sessions will be held; on September 16 they will have the opportunity of visiting Niagara Falls (*en route* westward by special train), and on September 17 will be entertained by the Geographic Society of Chicago; and on September 19 and 20 they will be invited to participate in the International Congress connected with the World's Fair in St. Louis. The subjects for treatment and discussion in the congress are classified as follows:—(1) Physical geography, including geomorphology, meteorology, hydrology, &c.; (2) mathematical geography, including geodesy and geophysics; (3) biogeography, including botany and zoology in their geographic aspects; (4) anthropogeography, including ethnology; (5) descriptive geography, including explorations and surveys; (6) geographic technology, including cartography, bibliography, &c.; (7) commercial and industrial geography; (8) history of geography; (9) geographic education. All correspondence relating to the congress and all remittances should be addressed, The Eighth International Geographic Congress, Hubbard Memorial Hall, Washington, D.C., U.S.A.

THE death is announced of M. Firmin Bocourt at the age of eighty-five years. M. Bocourt was formerly curator of the Paris Museum of Natural History, and during his life took part in important expeditions to Siam, Mexico, and to Central America.

THE *British Medical Journal* announces that the Senatus Academicus of the University of Edinburgh has awarded the Cameron prize in practical therapeutics to Prof. Niels R. Finsen, of Copenhagen, in recognition of his pioneer work in connection with the application of light rays to the treatment of disease.

AT the jubilee meeting of the Royal Scottish Arboricultural Society held in Edinburgh on Tuesday, a resolution was agreed to expressing the opinion that the Board of Agriculture should now take steps to give effect to the recommendation of the departmental committee on forestry, so far as Scotland was concerned, by providing an estate to serve as a State forest demonstration area, and also by providing experimental plots in connection with Edinburgh University. The motion also expressed the view that forestry education in the country would not be adequately provided for until these facilities were provided and a thoroughly equipped forestry school was established in Scotland.

ON Tuesday next, February 23, Mr. F. Foxwell will deliver the first of three lectures at the Royal Institution on "Japanese Life and Character," and on Thursday, February 25, Prof. H. L. Callendar will commence a course of three lectures on "Electrical Methods of Measuring Temperature." The Friday evening discourse on February 26 will be delivered by Mr. Alexander Siemens, his subject being "New Developments in Electric Railways"; on March 4 by Prof. W. Stirling, on "Breathing in Living Things"; and on March 11 by Prof. F. T. Trouton, on the "Motion of Viscous Substances."

At the fourth monthly dinner of the London Chamber of Commerce on February 10, a discussion took place on "British Industrial Neglect of Applied Science." Sir Arthur Rücker occupied the chair; and in opening the debate said it was no doubt true that there had been in the past a certain want of appreciation on the part of English commerce, of that careful scientific training for those who were to take the leading parts in it, which was characteristic of education in some other countries. They had to ask themselves why it was that in this country the trained university man was not in the same demand in industrial circles as he was, for instance, in America; why it was that the right article was not asked for; and whose was the fault that it was not supplied. The matter of crucial importance was the fact that it was absolutely necessary to draw the educationist and the business man closer together. Among the subsequent speakers were Sir William Anson, Sir William Ramsay, Prof. Armstrong, and Prof. Meldola.

In connection with the centenary of the Royal Philosophical Society of Glasgow, Mr. G. T. Beilby delivered a lecture on "Advances in Chemical Industry during the Nineteenth Century" in the hall of the society on February 10. Summing up the position of chemical industry, Mr. Beilby remarked that it was evident that its widely international character, and its close touch with the most recent advances in chemistry, physics, engineering, and even with certain branches of biology, was making the position of its leaders a more and more exacting one. It was therefore imperative that the men who were to take the lead in the immediate future should be prepared with an equipment which would enable them to work, either in alliance or in competition, with the best men of any other nation. Referring to Mr. Chamberlain's recent injunction to the financiers in the City of London "to think Imperially," Mr. Beilby proposed to his fellow-workers in applied science that they should strive "to think scientifically and internationally," in order that they might be prepared to measure themselves, not against the men of any narrow class or nationality, but against the best workers of the world.

The Great Northern and City Railway was opened to traffic at the beginning of this week. We gave a few particulars of this new tube on the occasion of its completion a few weeks ago. Certain alterations in connection with the signalling arrangements which were required by the Board of Trade had, however, to be made before the railway could be thrown open to the public.

A correspondent sends us a cutting from the *Homeopathic World* of January 1 in which it is stated that Prof. Wm. Harvey King, of New York, and Mr. Hammer have found that if a tube containing radium is immersed in water for a time, the water becomes radio-active and is capable of affecting a photographic plate. Prof. King is said to be testing the therapeutic value of water that has thus been subjected to the action of radium.

In Nature of October 22, 1903 (vol. lxviii. p. 599), a peculiar kind of lightning was described by Prof. W. H. Everett, its remarkable feature being that it ascended in rocket fashion from a cloud into clear sky. Referring to the observations of flashes of ordinary character described by Mr. W. A. Lee in Nature of January 7 (p. 224), Prof. Everett writes to say there could be no mistake about the rocket-like flashes seen by Prof. P. Bruhl and himself. Prof. Bruhl, in confirming the observations, says:—"The three main characteristics of those flashes were that they were unbranched, that they passed upwards into the clear sky, and, what is probably connected therewith, their duration was undoubtedly longer than that of ordinary flashes."

A meeting of the Nagri Sabha, Benares, for the compilation of an authoritative Hindi dictionary of scientific terms was held, the *Pioneer Mail* states, early in January. The glossaries prepared by the Sabha of the mathematical, the astronomical, the philosophical, and the chemical terminologies were revised and finished. The revision of the first three was, comparatively, an easy task, on account of the existence of suitable Sanskrit equivalents, but the discussion on the chemical glossary was more protracted. Most of the English names of elements were adopted with slight Hindised forms, as, for instance, *Karb* for carbon, *Sphur* for phosphorus. The committee could not come to an agreement as regards a suitable Hindi term for oxygen. More than seven names were suggested, but each one was considered unsuitable and was rejected. It was finally resolved to consult Drs. J. C. Bose and P. C. Rây, of Calcutta, and Prof. Deshmukh, of Bombay, on the point.

The report of the medical officer of health for the City of London for the six weeks ending December 31 is mainly occupied with a review of the fourth report of the Royal Commission on Sewage. Dr. Collingridge is in general agreement with the remedial measures there suggested for dealing with polluted shell-fish, but considers that the controlling authority for the Thames should be the Corporation of London as Port Sanitary Authority so far as their jurisdiction over the river now extends. The remainder of the report contains the statistical data and records of the seizures of sewage-polluted shell-fish.

In addition to the articles of a more technical character in the December (1903) number of the *Johns Hopkins Hospital Bulletin* (vol. xiv., No. 153), Dr. C. A. Herter writes pleasantly of the influence of Pasteur on medical science. He remarks that the most significant feature perhaps of Pasteur's contributions to medicine is their direct dependence on the principles of physics and chemistry, and that sound medicine must rest on sound biological conceptions. It is also announced that it is proposed to found a memorial to Major Walter Reed, to whom in a large degree is due the discovery of the mode in which yellow fever is spread by the mosquito.

Of new journals there would seem to be no end, two of the latest additions being the *Archivio di Fisiologia*, edited by Prof. Fano, of Florence, and the *Journal of Infectious Diseases*, edited by Dr. Hektoen and Mr. Jordan. The former will deal especially with experimental physiology. The *Journal of Infectious Diseases* has been established in connection with the Memorial Institute for Infectious Diseases, Chicago, by the munificence of Mr. and Mrs. Harold F. McCormick. It will be devoted to the publication of original investigations dealing with the general phenomena, causation and prevention of infective diseases. The first number (January) is a volume of 200 pages, excellently printed and well illustrated, and contains a number of papers of considerable interest and value, *e.g.* the cultivation of *Trypanosoma Brucei*, by Messrs. Novy and McNeal; spotted fever, by Messrs. Wilson and Chowning; a study of thyrotoxic serum, by Mr. Portis; changes in the bacterial flora of sewage, by Messrs. Winslow and Belcher, &c.

An addition to the fragmentary information now existing concerning the life of Nicolò Tartaglia is discussed by M. V. Tonni-Bazza in the *Atti dei Lincei*. Tartaglia, who died in 1557 at the age of fifty-seven, is best known to modern mathematicians for the part he played in the resolution of the cubic equation, and the document in question is an application for the copyright of the work which Tartaglia issued in 1546 entitled "Quesiti et inuentioni diverse."

THE *Bulletin* of the French Physical Society contains a preliminary account of the work of the French Geodetic Expedition which was sent out in 1901 to measure a new base line in the region of the Andes. In addition to this work the expedition has undertaken a series of measurements of the intensity of gravitation at Riobamba (altitude 3000 metres). These observations confirm Bouguer's formula for reduction to sea-level, which takes account not only of the altitude, but also of the attraction of the underlying stratum of earth. If, following the views of certain geodetists, the correction due to the second cause is omitted, discordant results are obtained.

THE last addition to the "Manueli Hoepli" is a pocket-book on the mathematical theory of elasticity by Prof. Roberto Marcolongo, of Messina. The book is written for students who have received a general preliminary training in the methods of higher mathematical analysis; at the same time the introduction of the subject of elasticity proper is preceded by two chapters dealing with harmonic functions, the theory of the potential, Green's, Gauss's and Dirichlet's theorems and allied matters. The book should afford an excellent introduction to the general theory of the equations of elasticity; for the discussion of special problems the reader is referred to the larger treatises on elasticity.

THE February number of *Knowledge and Scientific News* gives an account of what appears to be the first successful achievement of artificial flight, by Messrs. Orville and Wilbur Wright. That these brothers have been successful in gliding experiments performed under gravity is well known, but they now appear to have succeeded in raising themselves from the ground by a motor-driven machine which, after running along a mono-rail for 40 feet, rose into the air, and was driven in the face of a gale blowing at about 25 miles an hour, with a velocity of about 10 miles an hour relative to the ground, or 35 miles an hour relative to the wind. In the last trial the machine flew half a mile relative to the air, or 852 feet relative to the ground. It is sincerely to be hoped that this success will not, as in so many previous instances, be followed by a fatal accident.

A BIOGRAPHICAL notice of Prof. Angelo Maffucci, whose death on November 24 has already been noted, is contributed to the *Atti dei Lincei* by Signor Foà. Maffucci was born at Calitri, in the province of Avellino, on October 17, 1847, and his family, being farmers, naturally wished him to become either a farmer or a priest, but he preferred to go to Naples and study medicine. In 1873 he gained a medal for his campaign against the cholera, and some time later he became assistant in the Institution of Pathological Anatomy under Prof. von Schrön. In 1882 he was appointed professor of pathological anatomy at Catania, and in 1884 was elected to a chair at Pisa, which he held until his death. His most important work dealt with the infection of the embryo by the tubercle bacillus, as bearing on the heredity of tuberculosis. He received the Balbi-Valier prize of the Venetian Academy and the gold medal of the Società dei Quaranta (Society of the Forty). When near his death he proposed to found a scholarship in pathological anatomy at Pisa.

IN the first part of vol. lxxvi. of the *Zeitschrift fur wissenschaftliche Zoologie* Prof. E. Rohde continues the account of his investigations into the structure of the organic cell. A second article, by Mr. A. Kölliker, is devoted to the development and origin of the vitreous humour of the eye, the author arriving at the conclusion that this structure, although essentially of ectodermal origin, in the course of its development includes certain mesodermal elements. The remaining contents of this part include an account of the "Tömösvarysche organ," found at the base of the antennæ of myriopods, by Dr. C. Hennings, and an article, by Mr. C. Thesing, on spermatogenesis in cephalopods.

"CURRENT Misconceptions in Natural History" is the title of an article by Mr. J. Burroughs in the February number of the *Century Magazine*, in which the author deprecates the popular tendency to invest animals with human attributes and human modes of thought. Especially is the author convinced that animals do not consciously teach their offspring, urging the improbability of their being able to reflect upon their future any more than upon their past, or that they are solicitous about the future well-being of their young any more than about their own ancestry. With great fairness Mr. Burroughs quotes, however, a letter from President Roosevelt in which somewhat opposite opinions are expressed, the President stating his belief that "there is a large amount of *unconscious* teaching by wood-folk of their offspring." Possibly, as the author states, the divergence of view is largely owing to the difference in meaning attached by the two writers to the same words.

THE *Rapid Review*—a new magazine issued by Messrs. C. Arthur Pearson, Ltd.—contains three pages dignified by the title "The Science of the Month," in which extracts are given from published articles on the physiology of fatigue, plants and anæsthetics, and cancer, and from reports of Prof. Lankester's Royal Institution lectures on extinct animals.

MESSRS. SWAN SONNENSCHEIN AND CO., LTD., have published the "Public Schools Year Book" for 1904. This useful work of reference was founded by three public school men representing Eton, Harrow, and Winchester, and the present is its fifteenth year of publication. Among important additions to the current issue are sections dealing with the education of engineers and musicians. The annual has become indispensable to parents sending their boys to a public school, and to the masters in such institutions.

A SEVENTH edition of "Dynamo-Electric Machinery," by Prof. S. P. Thompson, F.R.S., is being published by Messrs. E. and F. N. Spon, Ltd. With the development of the subject it has become necessary to divide the work into two parts. Part i. of the new edition has been issued, and deals only with machinery for continuous currents. The concluding part, describing machinery for alternating currents, is in the press, and is expected to appear during the present year. Chapters on dynamo design, which were published in 1902 as a separate book, are now embodied in the present work.

WE are asked to announce that the preliminary work for the Technolexicon of the Society of German Engineers must be concluded by Easter of this year, so collaborators are requested to send in all outstanding contributions. This universal technical dictionary for translation purposes, in English, German, and French, the compilation of which was begun in 1901, has received help up to the present time from 363 technical societies at home and abroad; 51 of these are English, American, South African, &c., 274 German, Austrian, and German-Swiss, and 38 French, Belgian, and French-Swiss societies. No less than 2573 firms and individual collaborators have promised contributions to the dictionary. Communications referring to the dictionary should be addressed to Dr. Hubert Jansen, Berlin (NW. 7), Dorotheenstrasse 49.

A RECENT number of the *Comptes rendus* contains an important paper by Prof. Becquerel on the light emitted spontaneously by certain salts of uranium. The light emitted is out of all proportion to the feeble radio-activity of the salts, and is most marked in those salts which phosphoresce most brilliantly when exposed to light. In the case of the double sulphate of uranyl and potassium, it was found that whilst different specimens varied in phosphorescent and luminescent power, the light emitted was the same, whether the salt had been kept in the dark during eight years or had been recently exposed to the light of an arc or to the radiations of radium salts. It is of interest to note that the author is of opinion that the study of uranium and thorium would have led, though perhaps somewhat slowly, to the recognition of most of the facts which have been brought to light by the investigation of radium and polonium.

IN the *Sitzungsberichte* of the Prussian Academy Prof. Richarz and Dr. Schenck direct attention to some very striking "analogies between radio-activity and the behaviour of ozone." Freshly prepared ozone and ozone that has been decomposed by deozonisers have the power of causing condensation in a steam jet, and impart conductivity to the air in a similar manner to those metallic salts which emit Becquerel radiation. The photographic effect of radio-active substances has also been observed in the case of ozone, and although it does not act upon barium platinicyanide or zinc oxide, it causes hexagonal zinc blende to fluoresce brightly, and this is regarded as evidence that massive ions are produced comparable with the α rays of radium and the canal rays of the vacuum tube. Platinum that has been in contact with ozone exhibits induced radio-activity, and it is suggested that the slight conductivity normally observed in the atmosphere and certain of the effects produced by radio-active bodies may perhaps be due to the formation and decomposition of ozone or hydrogen peroxide.

AN ingenious apparatus for measuring the electrical conductivity of aqueous solutions at high temperatures is described by Messrs. Noyes and Coolidge in the *Zeitschrift fur physikalische Chemie.* The conditions to be satisfied were that the vessel should withstand, without leakage, pressures up to the critical pressure of water, that the lining of the vessel should be entirely unacted on by aqueous solutions, that the electrodes should be efficiently insulated from the walls of the vessel at temperatures exceeding 300° C., and that the temperature should be maintained constant within 0·1° C. The desired result was accomplished by using a steel bomb lined with platinum and closed by a washer of pure gold wire. The electrodes were of steel covered with platinum foil, and were bolted into the top and bottom of the bomb, from which they were insulated externally by means of mica and internally by means of rings of quartz-crystal made tight by gold washers. The whole apparatus was heated in a vapour bath, and conductivity measurements could be made with an accuracy of 0·25 per cent. up to 300° C., whilst the fouling of the solutions was inappreciable even at 1/2000 normal.

THE additions to the Zoological Society's Gardens during the past week include a Bonnet Monkey (*Macacus sinicus*) from India, presented by Mr. F. Glockler; two Yellow-winged Parrakeets (*Brotogerys virescens*) from Brazil, a Senegal Parrot (*Pococephalus senegalus*) from West Africa, two Golden Eagles (*Aquila chrysaëtus*), European, presented by Mr. Charles E. Lister; a Royal Python (*Python regius*) from West Africa, presented by Mr. Cecil T. Reaney; a Simpae Monkey (*Semnopithecus melanophus*) from Sumatra, an Indian Brush-tailed Porcupine (*Atherura fasciculata*) from Siam, a Great-billed Weaver-bird (*Ploceus megarhynchus*) from India, deposited.

OUR ASTRONOMICAL COLUMN.

EPHEMERIS FOR THE MINOR PLANET (7), IRIS.—The following is an extract from an ephemeris for the minor planet Iris published by Dr. J. Riem in No. 3926 of the *Astronomische Nachrichten.* It will be remembered that Prof. Wendell recently announced the discovery of a variation in the brightness of this planet, having a range of 0 5 to 1·0 magnitudes:—

1904	α h. m. s.	δ ° ′	log r	log Δ
Feb. 17	6 36 26	+17 41·5	0·332	0·136
,, 21	6 37 12	+17 41·3	0·334	0 150
,, 25	6 38 30	+17 41·1	0·336	0 164
,, 29	6 40 19	+17 40·9	0·338	0·179
Mar. 4	6 42 36	+17 40·4	0·340	0·194
,, 8	6 45 17	+17 39·6	0·342	0·208

Magnitude, February 5=7·9, March 8=8 5.

OBSERVATIONS OF MARS DURING 1903.—The general results of the observations of Mars made by Mr. Denning during 1903 are published in No. 3926 of the *Astronomische Nachrichten.* A 10-inch reflector with powers of 252, 312, 332, 450 and 488 was used, and the power 312 was found to be the most effective.

The streaks, or canals, on the planet's surface appeared to be, without doubt, objective features, but no "doubling" was observed. Decided changes were observed to take place in the appearance of some of the markings, but Mr. Denning attributes these apparent changes to the drifting of vaporous condensations over the permanent markings rather than to any real modifications of the latter. Many brilliantly luminous areas were observed, and although they exhibited decided changes, Mr. Denning believes them to be permanent features, and urges that more definite observations of their latitudes and longitudes should be made and recorded. A curious feature of these bright markings is that they appear brighter when on the edge of the planet's disc than they do at its centre, behaving, in this respect, like faculæ on the sun's disc. One rotation p riod for the planet satisfies the observations of all the markings, thus proving them to be definite features of the planet's surface rather than drifting vapours such as are seen when observing Jupiter and Saturn.

Comparing the recent results with those obtained in February, 1869, Mr. Denning has determined the rotation period of Mars to be 24h. 37m. 22 7s. As this is the mean of 12,136 rotations, it should be a very accurate value. Six drawings of the Martian surface, made on different dates during 1903, accompany Mr. Denning's communication.

A CATALOGUE OF 829 SOUTH POLAR STARS.—No. 21 of the *Contributions from the Observatory of Columbia University* is devoted to a catalogue of 829 stars, all within 2° of the South Pole, compiled by Prof. Harold Jacoby, acting director of the observatory.

The star places in the catalogue have been obtained from measures of twelve plates taken at the Cape Observatory. Four of these plates overlap and cover the region within 1° of the pole; the remaining eight contain regions symmetrically arranged about the inner four at different hour angles, so that they cover the whole region within 2° of the pole. In measuring these plates the star places, as determined from each plate, were corrected for refraction, &c., and then plotted on one large chart, so that the unknown stars common to any two or more plates overlapped. The effects of errors of observation, and the uncertainty due to the possibly different scale-values of each plate, were then eliminated, and the whole chart was oriented from the known positions of some of the included stars as determined by Sir David Gill at the Cape Observatory. The relative positions thus determined should be very accurate, and are given in the catalogue for the epoch 1895, together with

the catalogue number, the magnitude, the south polar distance, the C.P.D. number, and the exact precessional corrections for each star.

THE CLIMATOLOGY OF 1903.—As in former years, the meteorologist of the Juvisy Observatory, M. J. Loisel, has published the detailed results of the observations made at that observatory during the past year in the *Bulletin de la Société astronomique de France* (February).

The results are graphically depicted by a series of curves, one set of which shows and compares the rainfall, the direction of the wind, the temperature, pressure and hygrometric state of the atmosphere, the number of hours of sunshine, the state of the sky, and the declination and phase of the moon for each day. A set of tables comparing each of the four seasons with the corresponding season for each year since 1886 shows that, on the whole, the winter was warm, the spring dry, the summer cold, and the autumn warm during 1903 as compared with the mean conditions. The curve depicting the amount of the effective insolation shows that during 1903 there were two maxima, one in May the other in July, instead of one in July as shown on the curve for 1902. A comparison of the total solar radiations observed during 1902 and 1903 gives 146,115 and 140,175 calories respectively.

MERIDIAN-CIRCLE OBSERVATIONS AT THE LICK OBSERVATORY.—The results of the meridian-circle observations made at the Lick Observatory during the period August, 1896, to March, 1901, by Mr. Richard H. Tucker have just been published in one volume (*Publications* of the Lick Observatory, vol. vi., 1903). The results include about 11,700 full observations, and 2700 observations in one coordinate only, for the determination of 4500 stars.

The first part of the work consists of the results of the observations for declination of 301 latitude stars previously observed by Prof. Doolittle at South Bethlehem, Pa, and includes 107 stars from the "Standard Catalogue" of Lewis Boss. The resulting declinations are compared, where the stars are common to the catalogues, with those given in Boss's catalogue and the Berliner Jahrbuch.

The second part of the volume is devoted to the observations of 21 circumpolar stars, all above declination +82°, in compliance with a request of Dr. Auwers. Part iii. gives the results of the observations of 50 zodiacal stars, made during 1898 at the request of Sir David Gill to furnish places for his heliometer measures of the major planets.

The volume also contains a description of the observations, and their reduction and final results, of 3088 southern stars contained in the catalogue observed by Piazzi, at Palermo, during the period 1792 to 1813.

The stars in the first and second lists of the Astrophotographic Conference, of comparison stars for Eros, were observed at Lick, and the results are given and discussed in the fifth section of the volume.

The observations are concluded with the results obtained in some miscellaneous observations made during the period 1897 to 1901. These include 49 comparison stars for various purposes, 20 proper-motion stars observed for Prof. J. G. Porter, of Cincinnati, and several meridian-circle observations of Eros, Nova Persei, and two comets.

M. BLONDLOT'S n-RAY EXPERIMENTS.[1]

IN his experiments on the rapidity of propagation of the Röntgen rays, the French academician, M. R. Blondlot, discovered a new kind of rays, which he called *n*-rays, after the place Nancy, in which they were first observed.[2] These rays are said to be emitted by an Auer burner, or better still by a Nernst lamp of 200 watt power. Like the Röntgen rays, they are said to pass through aluminium with ease, but on the other hand to be absorbed by the slightest film of water, like the longer heat-waves. Although they are stated to be absorbed by cold platinum, they readily pierce red-hot platinum.

Blondlot has recently found that these *n*-rays are emitted by the wire of the Nernst lamp even after this has been extinguished for several hours, and that, moreover, flints which have been exposed to the sun's rays have a distinct effect in the sense of the *n*-rays.

In all these observations of Blondlot the action of the *n*-rays consists in general of a brightening of a source of light under these rays, or rather of a darkening when the rays are cut off by interposing either the hand or a lead screen between the source of light and the source of the *n*-rays. The analysing source of light may be a small spark, a bluish flame, a phosphorescent surface, a dark platinum plate at dull red heat, or the surface of paper feebly illumined by a source of light. The dimensions of all these analysing sources of light are very small (the illumined paper, for instance, being 2 mm. by 16 mm. in size), and the observation is carried on in a dark room.

Although the change in brightness is said to be considerable, neither Blondlot (*C. R.*, cxxxvii., 167, 1903), Rubens (Ebenda) nor others (*Phys. Zeitsch.*, iv., 732 and 733, 1903) have hitherto succeeded in demonstrating objectively the corresponding transformation of energy. At the same time the phenomena observed subjectively by Blondlot could not be perceived by Rubens and others in repeating the latest experiments with slightly illuminated or phosphorescent surfaces.

Without wishing, for the present, to dispute the objective existence of these *n*-rays, I should like in what follows to bring forward the fact that a whole set of Blondlot's experiments may be almost exactly imitated in their effects *without employing any source of illumination whatever*, and that the changes in form, brightness, and colour respectively of the analysing luminous surface observed by Blondlot under a stream of rays, and the interception of a diaphragm (Abblendung) may be referred to processes taking place in the eye itself, and, in fact, to the *contest between the rods and cones of the retina in seeing in the dark*.

It has been known for some time that the layer of rods and cones in the retina is the structure which is sensitive to light whereby this form of energy, from without, is transformed into nerve-stimulation. While, however, experiments on sharpness of vision have led to the assumption that the power of vision is due to the agency of the cones alone, the almost identical anatomical structure of the rods admits of the conclusion that they also play their part in vision. But on the ground of more recent physiological researches on vision in dim light, and the influence of the visual purple contained in the rods on colour-perception, we have been enabled to distinguish, more and more clearly, the respective modes of action of these two elements of the retina and to ascribe to them their different functions. A. König[1] had already ascribed to the rods the colourless vision of the totally colour blind in every degree of brightness, the non-perception of colour in a very dim light of those otherwise able to perceive colours, and the perception of blue. J. v. Kries[2] went further, and disposed of the still existing difficulties and contradictions by putting forward the hypothesis that the cones form our colour-perceiving "light apparatus" ("Hellapparat") and the rods our totally colour blind "dark apparatus" ("Dunkelapparat"). According to this theory of Kries the cones render vision possible in a very bright light, and their stimulation by light-waves arouses in the brain the perception of colour, while the purple containing rods are totally colour blind, and only come into action in a very dim light, and are endowed with the property of considerably increasing their sensitiveness in the dark. These properties of the rods are called by Kries "adaptability to the darkness" (Dunkeladaptation). Before the cones perceive coloured light, the rods bring about in the brain the impression of colourless light.

We know from the anatomy of the eye[3] that the fovea centralis contains cones only and no rods, and that the rest of the retina has rods as well as cones, the former predominating towards the periphery, and it is also well known

[1] Translation of "Notes in Elucidation of the Most Recent Researches of M. R. Blondlot on the *n*-Rays." By O. Lummer. Read at the sitting of the German Physical Society, November 27, 1903.

[2] R. Blondlot, "Sur de nouvelles actions produites par les rayons *n*; généralisation des phénomènes précédemment observés" (*C. R.*, cxxxvii., 684, 1903). "Sur l'emmagasinement des rayons *n* par certains corps" (*C. R.*, cxxxvii., 729, 1903).

[1] "Über den menschlichen Sehpurpur und seine Bedeutung beim Sehen (*Sitzber.* d. Berl. Akad. d. Wissensch., S. 577, 1894).

[2] "Über die Funktion der Netzhautstäbchen (*Zeitsch.* f. Psych. u. Physiol. d. Sinnesorgane, ix., 81–123, 1894).

[3] R. Greef, "Die mikroskopische Anatomie des Sehnerven und der Netzhaut." Aus dem "Handbuch der Augenheilkunde" von Graefe u. Samisch. 2 Aufl., I. Bd., V Kap. (Berlin. 1901.)

that the fovea centralis is the special point of vision when looking at an object and fixing our eyes upon it. *Hence it follows that in gazing at an object, i.e. direct vision (foveal), the rods are excluded, and it is only in indirect vision (peripheral) that they come into action.* Thus then in dim light these two elements enter into a sharp contest which, if the light is dim enough, results in favour of the colour-blind rods, so that everything then resolves itself into greys, *i.e.* colourless shades of light.

By the help of this theory one gets a natural explanation of phenomena hitherto unexplained, as, for example, Purkinje's phenomenon, the change of position of the "neutral point" in the spectrum as light decreases in the case of those who confound red with green, and the dependence of colour identification on the absolute intensity of light. In my work "Grauglut und Rotglut" I was able to show[1] that the remarkable "shadow-like" (gespensterhaft) appearance of the grey and red glow can be explained by attributing to the two light-perceiving elements the part assigned to them by v. Kries.

If in a dark room we observe the gradual rise in temperature of a body from that of the room up to glowing temperature, then, according to my view, the eye perceives two sudden changes or "leaps," first from dark to shadowy grey ("grey glow"), and later from grey glow to coloured glow (red glow). In each case the "leap" arises from stepping over the threshold of stimulation of the optic nerve, but the efficient organs are not the same in the two cases; the grey glow corresponds to the threshold of stimulation of the rods, the red glow to the threshold of stimulation of the cones. *Accordingly we must conceive of the grey glow as a sensation of the retinal rods and of the red glow as the sensation of the retinal cones.*

The "shadow-like" character of the rod-vision is not apparent until we observe a sufficiently small surface the retinal image of which does not exceed in area that of the spot of clearest vision, *i.e.* the fovea centralis, and the increase of brightness of which we follow in the dark from zero upwards. For this purpose it is best to make use of a platinum plate brought to a glow by means of electricity and limited by a diaphragm, the development of light thus being observed in the dark by a well-rested eye. When the platinum plate has reached a temperature of about 400° C., at first only the rods of the eye searching in the dark are stimulated, and the perception of colourless light (grey glow) is aroused in the brain.

Being accustomed to gaze at what sends us light we turn our eyes in the direction from which we believe the light rays come. As, however, the cones have not yet been stimulated, the fovea centralis sends no message of light to the brain; accordingly we cannot see the spot gazed at. Thereby we are confronted by the remarkable fact that we see something which we are not gazing at, whilst it becomes invisible when we wish to fix our eyes upon it. And as we can see nothing by direct vision, we involuntarily move our eyes away, whereby the rays again fall on extra-foveal retinal spots; we again receive the impression of light, and our search after the place from which the remarkable light comes begins over again. Thus there arises in us the impression of a light which darts to and fro, which is sometimes present, then again evades us, mocking us, like a will-o'-the-wisp. It is only when the brightness is of a sufficient intensity to stimulate the cones also and enable them to send a message of light to the brain that this unusual condition comes to an end, and then we see what we gaze at, just as we have been accustomed to do, and the thing seen no longer escapes the searching gaze.

In the case of glow this does not occur until the body has reached a temperature somewhat above 500° C.; not until then are the cones stimulated, and we then perceive colour as well as brightness, in other words, the "grey glow" is transformed into "red glow."

But at a still higher temperature (up to 700° C. and above) the rods enter into vigorous competition with the cones, and the light red colour seen in gazing at the platinum plate changes in indirect vision into a peculiar colourless white, the "rod white," while at the same time the brightness of the platinum plate increases considerably.

[1] O. Lummer, "Über Grauglut und Rotglut" (*Wied. Ann.*, lxii., 14–29, 1897; *Verh.* Phys. Ges. Berlin, xvi., 121–127, 1897).

In some of Blondlot's experiments one finds oneself in precisely the same position as in the observation of the "shadowy vision" just described. One perceives a very small slightly luminous surface, *e.g.* a dull red glowing platinum plate, in the dark and fixes one's gaze upon it. Before bringing one's undivided attention to bear on it, it is seen by the extra-foveal parts of the retina, because the eye involuntarily endeavours to gather as much light as possible, thus consequently both rods and cones take part in the vision. As soon, however, as the lead screen or the hand is interposed between the source of illumination and the luminous platinum surface, the observer, in order to see the change in it, will fix his gaze as directly as possible on the platinum plate, thereby excluding the rods. The necessary consequence will be that the platinum plate will appear reddish and less bright, and the rod-white of the peripheral parts of the retina be lost. But this fixing of the gaze requires time and effort. The darkening and the red colouring observed will also require a certain amount of time, and as soon as the hand or the screen is removed the eye will return as quickly as possible to extra-foveal observation, in which it receives more light. After the removal of the screen, therefore, the brightness of the platinum plate increases, and provided the brightness of the luminous surface under observation is very dim, there will be an immediate diminution in the distinctness of the outlines on darkening it while the gaze is fixed on it, in fact, there will eventually be a complete disappearance of the platinum plate provided the energy sinks below the threshold of stimulation of the cones and the surface is small enough.

As a proof that the phenomena here described (which were not only observed by myself subjectively, but were produced in my lecture before a large audience) resemble to an extraordinary degree the more recent observations described by Blondlot, I will quote, word for word, two sentences from his article of November 2, 1903 (*C. R.*, cxxxvii., 685, 1903). After describing the order of procedure in the observation of a feebly illumined strip of paper, he goes on to say:—"If one now intercepts the rays by interposing a lead plate or the hand, one sees the small rectangle of paper grow dark to its contour and lose its distinctness; the removal of the screen causes the brightness and the distinctness to reappear, the light diffused by the strip of paper being then increased by the action of the *n*-rays."[1]

In the case in which Blondlot observes the transparently luminous paper mirrored on a needle and then illumines the needle with the *n*-rays, he describes the process in the following words:—"It was then easy to prove that the action of these rays strengthens the image, for if one succeeds in intercepting them, this image becomes dark and reddish. I have repeated this experiment with equal success by employing instead of the knitting-needle a plane bronze mirror."[2]

In this article it is also stated:—"All these actions of the *n*-rays on light require an appreciable time for their production and disappearance";[3] this is on a parallel with the appearances of grey and red glow during vision in the dark. The experiments described in this article do not deal with the behaviour of different substances under exposure to the *n*-rays. It is unnecessary to say that seeing in the dark can in no wise explain why some substances transmit the *n*-rays and others do not. But it may be asserted briefly that neither brightening, darkening, nor change in colour will take place if during the experiment with the above mentioned source of light one gazes continuously at the analysing luminous surface so that the image always falls on the fovea centralis and the cones alone come into action. As a matter of fact, Prof. Rubens, as he kindly informed me in answer to my question, took his observations in this way, and could perceive no brightening even

[1] "Si maintenant on intercepte les rayons en interposant une lame de plomb ou la main, on voit le petit rectangle de papier s'assombrir, et ses contours perdre leur netteté; l'éloignement de l'écran fait reparaître l'éclat et la netteté; la lumière diffusée par la bande de papier est donc accrue par l'action des rayons *n*."

[2] "Il fut alors facile de constater que l'action de ces rayons renforce l'image, car si l'on vient à les intercepter, cette image s'assombrit et devient rougeâtre. J'ai répété cette expérience avec le même succès en employant, au lieu de l'aiguille à tricoter, un miroir plan en bronze."

[3] "Toutes ces actions des rayons *n* sur la lumière exigent un temps appréciable pour se produire et pour disparaître."

when a very powerful Nernst lamp was employed. Moreover, this sustained gaze is always accompanied by great fatigue, for reasons already adduced, and especially so in observing a very feebly luminous surface of small area in a dark room. The sustained gaze at small bright objects, as is well known, is, in fact, the most effectual way of inducing hypnotic sleep.

But although one cannot imitate all M. Blondlot's experiments by purely subjective perceptual processes without employing some source of illumination, I have thought it advisable to direct attention to these more recent physiological discoveries, the more so as M. Blondlot pays no attention to them in any of his publications, and does not state with what visual apparatus one ought to observe, nor does he give warning of the illusions one may fall into in carrying out his experiments. But the foregoing statements will at least serve to remind all those who take the trouble to repeat M. Blondlot's experiments that in vision in the dark changes in brightness, form and colour may arise from a purely subjective source. These purely subjective changes, however, do not depend upon any optical illusion, but, like the "shadow-like" appearances of the "grey glow" and the "red glow," are brought into existence by the competition between the two elementary structures of the visual organ, and correspond to objective processes in the retina.

As soon as the phenomena observed by M. Blondlot shall have been incontestably proved by means of objective instruments of precision, these few remarks on the *n*-rays will be only of secondary importance.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—At a meeting held at The Museums, Cambridge, on February 8, Prof. Newton, F.R.S., being in the chair, it was decided to take steps to perpetuate the memory of the late Mr. J. S. Budgett. Since his return from his last expedition to Africa, Mr. Budgett had made some important observations on the material collected by him, but a large part of the valuable material which he gave his life to obtain was necessarily untouched by him. It is proposed that this should be worked out by some of his friends, and the results published, with the observations and drawings which he had himself made. The work would be edited by Prof. J. Graham Kerr, and suitably illustrated. It is also proposed, if the funds available are sufficient, to add to the volume a reprint of all Mr. Budgett's former writings, so that the volume will become a memorial of his life's work. Subscriptions towards the cost of preparing this volume should be sent to Mr. A. E. Shipley, Christ's College, Cambridge.

A VERBATIM report of the conference of teachers, held under the auspices of the London Technical Education Board on January 7–9, appears in the *London Technical Education Gazette*—the official circular of the Board for January and February.

AT a joint meeting of the academical and university councils of Paris, some interesting remarks were made by M. Liard arising out of the recent changes according to which professors of secondary education were last year, for the first time, allowed to sit on juries for the baccalaureate. An opportunity has been given to these professors of expressing an opinion on the work submitted to them, and they all agree in considering that the subjects studied seem to appeal to the memory rather than to the faculties of observation, reflection and judgment.

THE Childhood Society, the object of which is the scientific study of the mental and physical conditions of children, has arranged a course of four public lectures to be given at the Sanitary Institute, commencing on Thursday, February 25. The lectures will be as follows:—"Some Elementary Aims in Education," by Mr. Hamilton Hall; "Protection of Feeble-minded Children during and after School Age," by Prof. W. A. Potts; "Physiology in the Curricula of Primary and Secondary Schools," by Dr. D. Sommerville; and "Child Punishments," by Dr. H. R. Jones.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, November 26, 1903.—"On the Distribution of Stress and Strain in the Cross-section of a Beam." By John **Morrow**, M.Sc. (Vict.), Lecturer in Engineering, University College, Bristol.

The author describes some experiments on the measurement of lateral or transverse strains in specimens of wrought and cast iron when subjected to bending. The instrument used for the determination of the displacements of the sides of a beam consists essentially of two cranked levers pivoted together. At one extremity these are in contact with the points on the specimen between which the change of length is required, while the relative motion of the other ends is measured optically by means of a fixed and a tilting mirror. This method of measurement allows of great precision and delicacy of reading. In this case the lateral displacements were observed to the nearest 1/400000 of a centimetre.

The beams used were about 3 cm. broad and 6·5 cm. deep, and they were supported on knife-edges about 90 cm. apart. Measurements of the transverse extensions or contractions were made at seven different points in the depth of the beam, while the applied bending couple was increased by definite increments of about 9347 kg.cm. each.

The actual strains proved to be appreciably smaller than those which might be expected from the Bernoulli-Eulerian theory.

The relations obtaining between the lateral and linear strains, for the materials in question, were found from independent experiments in direct tension and compression, and by a comparison of these with the transverse strains in the beams, the amount and distribution of the stresses over the cross-sections of the beams were inferred.

The results for cast iron specimens showed that, at the lower loads, the longitudinal stress varies as the distance from the neutral axis, but that in amount it is less than would be expected from theoretical considerations. As the load is increased, however, the strain diagrams become more and more curved in the direction of a decreasing strain at greater distances from the neutral axis, and this is accompanied by a displacement of the neutral surface towards the compression side of the beam.

It is well known that the existing theory does not give a completely satisfactory account of the actions in a beam. This paper is therefore important, not only for its own results, but because it opens up a new method of experimentally approaching this and the allied subjects, and so facilitates further research on similar lines.

February 4. "Conjugation of Resting Nuclei in an Epithelioma of the Mouse." By E. F. **Bashford**, M.D., and J. A. **Murray**, M.B., B.Sc. Communicated by Prof. J. Rose Bradford, F.R.S.

In a previous communication the authors directed attention to the fact that the power of cell proliferation, which has been proved to occur in an epithelioma of the mouse (Jensen), is a phenomenon unparalleled in the mammalia. A mass of tumour, 16 lb. in weight, has been produced by artificially transplanting portions of the original growth and its descendants.

In seeking to throw light on this fact, the authors have studied carefully the phenomena which follow the transplantations of portions of the tissue to new sites, and have found that the tumours which arise are the genealogical descendants of the cells introduced. They have studied the growth of the tumours which arise at successive stages of twenty-four hours. In a tumour removed on the eighth day, and less than half a split pea in size, conjugation of resting nuclei has been observed. To take a specific case, the nuclei of two adjacent cells are continuous through the cell wall by a tube-like bridge, in the middle of which a strand of nucleolar substance with fusiform swellings in either cell is visible. The cells of this particular case are adjacent to the stroma, and close to the outer surface of the young tumour.

February 11.—"On the Compressibilities of Oxygen, Hydrogen, Nitrogen, and Carbonic Oxide between One Atmosphere and Half an Atmosphere of Pressure, and on the Atomic Weights of the Elements Concerned.—Preliminary Notice." By Lord **Rayleigh,** O.M., F.R.S.

The observations now referred to were conducted with an apparatus designed upon the same lines as that already described.[1] It must suffice to mention that the only important modification lay in the fact that the two single volumes, which, when employed together, constitute the double volume, were used separately and alternately, so as to eliminate in each set of measurements any question as to what the ratio of these volumes exactly is. It is hoped to give a full description of the method when it has been extended to the examination of other gases, such as nitrous oxide and carbonic anhydride. The temperatures ranged from 10°–15°, and care was taken that in each measurement the mean temperatures should be almost exactly the same for the single and for the double volume.

The results were reduced much as previously explained, and give for the values of B, which, according to Boyle's law, should be unity,

Oxygen	1·00040
Hydrogen	0·99976
Nitrogen	1·00017
Carbonic oxide	1·00028

B here denotes the quotient of the value of pv at the half atmosphere by the corresponding value at the whole atmosphere. That it would be less than unity in the case of hydrogen, and exceed unity for the other gases, is what would be anticipated from their behaviour at higher pressures.

If we measure p in atmospheres, and assume, as has usually been done, *e.g.* by Regnault and Van der Waals, that at small pressures the equation of an isothermal is

$$pv = PV(1 + ap),$$

where PV is the value of the product in a state of infinite rarefaction, then

$$a = 2(1 - B).$$

Probably the chief interest of a knowledge of the coefficient a is the application to deduce a correction to the relative densities of gases as observed at atmospheric pressure, so as to determine what would be the relative densities in a state of great rarefaction, to which alone Avogadro's law is applicable.[2]

Taking oxygen as a standard, we see that the small correcting factor to be introduced in order to pass from the ratio of densities at one atmosphere to that at great rarefaction is $(1+a)/(1+a_0)$, or $1+2(B_0-B)$, the suffix o relating to oxygen, that is, as follows:—

Hydrogen	1·00128
Nitrogen	1·00046
Carbonic oxide	1·00024

The double of the first number, viz. 2·0026, represents, according to Avogadro's law, the volume of hydrogen which combines with one volume of oxygen at atomspheric pressure to form water. Direct determinations by Scott gave 2·00245, and Morley, in his later work, found 2·0027, so that there is here a good agreement.

The following table gives the densities of the various gases, referred to oxygen = 16, at atmospheric pressure and at very small pressure, as deduced from my own observations.[3]

Gas.	Atmospheric pressure.	Very small pressure.
Hydrogen	1·0075	1·0088
Nitrogen	14·003	14·009
Carbonic oxide ...	14·000	14·003

From the researches of M. Leduc and Prof. Morley, it is probable that the above numbers for hydrogen are a little, perhaps one thousandth part, too high.

[1] "On the Law of the Pressure of Gases between 75 and 150 Millimetres of Mercury" (*Phil. Trans.*, A, vol. cxcviii., pp. 417–51, 1902).
[2] The application to oxygen and hydrogen was made in my paper, "On the Relative Densities of Oxygen and Hydrogen" (Roy. Soc. *Proc.*, vol. l., p. 448, 1892; "Scientific Papers," vol. iii., p. 525.
[3] Roy. Soc. *Proc.*, vol. liii., p. 134, 1893; vol. lxii., p. 204, 1897; "Scientific Papers," vol. iv., pp. 39, 352

The uncorrected number (14·003) for nitrogen has already been given,[1] and contrasted with the 14·05 obtained by Stas. This question deserves the attention of chemists. If Avogadro's law be strictly true, it seems impossible that the atomic weight of nitrogen can be 14·05.

From the molecular weight of CO, viz. 28,006, we deduce, as the atomic weight of carbon, 12·006.

It should be mentioned that D. Berthelot[2] has, meanwhile, calculated very similar numbers, based upon the observations of Leduc.

Challenger Society, January 27.—Dr. E. J. Allen in the chair.—On behalf of the Marine Biological Association, Dr. **Allen** exhibited a chart showing the positions of freeing and recapture of marked plaice in the North Sea, and their probable lines of migration.—Dr. **Fowler** contributed notes on the vertical distribution of two Biscayan Chætognatha—*Sagitta serratodentata*, apparently seeking the surface by day, but deserting it for deeper water, down to 100 fathoms, by night or after rain; *Krohnia hamata*, represented merely by small and immature specimens between 50 and 500 fathoms, larger specimens occurring only between 500 and 2000 fathoms; none were captured between the surface and 50 fathoms. This observation tends to strengthen the theory of the continuity of the Subarctic and Subantarctic plankton by way of the mesoplankton.

Zoological Society, February 2.—H.G. the Duke of Bedford, K.G., president, in the chair.—Mr. R. **Lydekker** read a paper, illustrated by coloured lantern-slides, on the subspecies of the giraffe (*Giraffa camelopardalis*). The author enumerated ten subspecies, and pointed out the distinguishing characters of each.—A paper was read by Messrs. Oldfield **Thomas,** F.R.S., and Harold **Schwann** which contained an account of a collection of mammals from Namaqualand presented to the British Museum by Mr. C. D. Rudd. The collection consisted of 160 specimens, referable to 28 species or subspecies, of which one new species and three new subspecies were described in the paper.—Mr. F. E. **Beddard,** F.R.S., read a paper on the arteries of the base of the brain in certain mammals, based on observations he had made on individuals that had died in the society's menagerie.—Mr. G. A. **Boulenger,** F.R.S., read a paper which contained the descriptions of three new species of fishes discovered by the late Mr. J. S. Budgett in the Niger.—Mr. **Boulenger** also described the type specimen of the silurid fish, *Clarias laeviceps*, Gill, which had been entrusted to him by the Smithsonian Institution.

Faraday Society, February 2.—Dr. J. W. Swan, F.R.S., president, in the chair.—Notes on the welding of aluminium: S. O. **Cowper-Coles.** After referring to various machines and processes for welding aluminium, the author went on to describe his own process, which requires no flux or solder, and does not necessitate the hammering of the joint when in the pasty state, the process being especially suitable for wire, rods, and tubes.—Some applications of the theory of electrolysis to the separation of metals from one another: M. **Hollard.** The only principle hitherto involved in electrolytic separations has been based on the method of successive potentials, each metal depositing at the potential proper to that metal. In practice this principle has only been applied to metals (copper and silver, silver and bismuth, mercury and bismuth) the polarisation potentials of which are lower than that of hydrogen. Metals having polarisation potentials higher than that of hydrogen cannot be separated by gradual increase of the E.M.F., on account of the extremely small fraction of the current then used to precipitate the metal, hydrogen ions carrying most of the current. The author has therefore made use of three other applications of the theory of electrolysis, depending on (1) reduction of the resistance of the bath by suppressing the formation of gas at the anode; (2) influence of the nature of the kathode; (3) formation of complex salts.—Mr. G. Watson **Gray** read a short preliminary note describing an explosion of some high grade ferro-silicon that occurred spontaneously a short time ago at Liverpool. The gases evolved on boiling a specimen in distilled water were

[1] Rayleigh and Ramsay, *Phil. Trans.*, A, vol. clxxxvi., p. 187, 1895.
[2] *Comptes rendus*, 1898.

found to contain PH_3 and AsH_3. The former was in the greater proportion, and to that probably the explosions were due.

Mineralogical Society, February 2.—Dr. Hugo Müller, president, in the chair.—Mr. Harold **Hilton** contributed a paper on the gnomonic net. This net consists of lines giving equal longitudes and latitudes for every ten degrees on a plane touching a point on the equator, the former being hyperbolæ and the latter straight lines. The author pointed out how the net could be used for the graphical determination of angles between poles on the sphere.—Mr. G. T. **Prior** described a new sulphostannite of lead from Bolivia, to which he gave the name Teallite, in honour of the Director of the Geological Survey. The mineral in its graphite-like appearance resembles franckeite and cylindrite, but differs from them in not containing antimony. It has the simple formula $PbSnS_2$, and is orthorhombic with angles $c(001) \wedge o(111) = 62°$, $c(001) \wedge p(221) = 75°$, and $m(110) \wedge m'''(1\bar{1}0) = 86°$. It has a perfect cleavage parallel to $c(001)$ and a specific gravity of 6·36. In connection with the investigation of this mineral new analyses were made of franckeite and cylindrite.—Mr. W. F. **Ferrier** gave an account of his discovery of the deposits of corundum in Canada, and Prof. H. A. **Miers** described a visit to the Rashleigh collection of minerals now deposited in the Museum of the Royal Institution of Cornwall at Truro.

Chemical Society, February 4.—Dr. W. A. Tilden, F.R.S., president, in the chair.—It was announced that the council proposed to send a congratulatory address to Prof. Mendeléeff on the occasion of his seventieth birthday, Tuesday, February 9, which was also the date of his official retirement.—The following papers were read:—The constitution of epinephrine: H. A. D. **Jowett.** The hæmostatic constituent of suprarenal gland secretion was first isolated by Abel and Crawfurd, and was subsequently obtained by Takamine, who named it adrenalin, and by von Furth, who called it suprarenine. The author finds that this substance has the composition $C_9H_{13}O_3N$, and that when fully methylated and oxidised it furnishes trimethylamine and veratric acid, whence he suggests that it should be represented by the formula

$$C_6H_3(OH)_2.CH(CH_2OH).NHMe(1:2:4)$$

or

$$C_6H_3(OH)_2.CH(OH).CH_2.NHMe(1:2:4),$$

the latter being the more probable. Studies on the electrolytic oxidation of phenols, part i.: A. G. and F. M. **Perkin.** By the oxidation of pyrogallol, purpurogallin was obtained, whilst gallic acid furnished purpurogallincarboxylic acid.—Action of nitrogen peroxide on 1-nitrocamphene: M. O. **Forster** and F. M. G. **Micklethwait.** In this reaction a number of complex compounds were obtained the constitutions of which have not yet been determined.—The tautomeric character of the acyl thiocyanates: R. E. **Doran.** A study of the conditions under which acetyl thiocyanate reacts as such or as the tautomeric thiocarbimide.—Resolution of α-β-dihydroxybutyric acid into its optically active constituents: R. S. **Morrell** and E. K. **Hanson.** The physical characters of the two optically active acids which were obtained by fractional crystallisation of the quinidine salt of the racemic acid are described.—Aromatic compounds obtained from the hydroaromatic series, part i., the action of bromine on 3:5-dichloro-1:1-dimethyl-$\Delta^{2:4}$-dihydrobenzene: A. W. **Crossley.** A description of the derivatives obtained.—The action of nitrogen sulphide on organic substances: F. E. **Francis** and O. C. M. **Davis.** An enumeration of the cyanidins obtained by the action of nitrogen sulphide on aromatic aldehydes.—Dibenzoylchloroimide: F. D. **Chattaway.** The author claims priority, over Stieglitz and Earle, in the description of this compound and some of its derivatives.

Mathematical Society, February 11.—Prof. H. Lamb, president, and temporarily Prof. E. B. Elliott, vice-president, in the chair.—The following papers were communicated:—On the roots of the equation $\frac{1}{\Gamma(x+1)} = \text{const.}$: G. H. **Hardy.** When the constant on the right hand side is zero, the rate of increase of the nth root approximates to that of n when n is large, and this result constitutes an exception to a general law which regulates the relation of the rate of increase of the roots to that of the function. It is shown that when the constant is not zero the rate of increase of the nth root is that of $n \log n$, and the exception is removed. The significance of the result in relation to the theory of integral functions is discussed.—Some extensions of Abel's theorem on power series on the circle of convergence: G. H. **Hardy.** The extension is to double series. When a double power series converges on the locus that corresponds to the circle of convergence of a simple series, either (a) when summed first by rows, or (b) when summed first by columns, or (c) when the two suffixes are simultaneously increased, its sum is equal to the limit of the function at the corresponding point of the locus, provided the limiting operations are performed in ways that correspond to the three specified methods of summation.—On group-velocity: Prof. H. **Lamb.** The paper contains a new proof of the relation between wave-velocity and group-velocity, and the possibility of a negative group-velocity is discussed. If the group-velocity were negative, the waves and the groups would travel in opposite directions. Such a possibility has been suggested in connection with very intense absorption. Examples are given of mechanical systems free from dissipation which possess the required property. In such systems the disturbance that travels away from any source, when analysed into harmonic waves, is found to consist of waves travelling towards the source, but the groups by which the energy is propagated travel away from the source. The reflection and refraction of waves at the boundary of a medium in which the relation between wave-velocity and wave-length is compatible with a negative group-velocity are discussed, and the ratio of amplitudes of incident and reflected waves is found.—On a certain double integral: Prof. A. C. **Dixon.**—On an appropriate form of conductor for a moving point singularity: Prof. A. W. **Conway.**—On the irreducibility of perpetuant types: P. W. **Wood.**—On the representation of $\int_0^\infty \text{cn}\; xt\; e^{-t}\, dt$ and other like integrals by means of continued fractions: Prof. L. J. **Rogers.** The paper deals with a generalisation of the so-called "addition theorem" for Bessel functions of zero order. A series of functions $f_1, f_2, \ldots$ can be determined from a given function f so that $f(x+y) = Af(x)f(y) + Bf_1(x)f_1(y) + Cf_2(x)f_2(y) + \ldots$. The determinants that arise in the process of obtaining these functions are closely related to the process of converting a series into a continued fraction. It is generally difficult to complete the latter process, but the relation between the two processes leads to a simplification.

CAMBRIDGE.

Philosophical Society, January 18.—Dr. Baker, president, in the chair.—On differences between the spectra at anode and kathode in certain gases, and on probable reasons for those differences: Prof. **Liveing,** F.R.S. The author found that in hydrogen at 7 mm. pressure the light at the anode gives only the second spectrum of hydrogen, at lower pressure the kathode glow shows only the first spectrum, and by further reduction of pressure the second spectrum is driven quite up to the anode and is then seen only in a bright spot upon the anode. The behaviour of the two banded spectra of nitrogen is exactly similar. In pure oxygen the anode is dark, but the kathode glow emits all the three spectra described by Schuster. The anode spectrum of the halogens is a continuous one, while the kathode glow gives a spectrum of lines, and the gas along the whole line of the discharge emits rays which, like kathode rays, make the tube fluoresce. The vapours of such metals as could be readily observed in glass tubes give each but one spectrum, the same in all parts of the tube. The spectra of the two oxides of carbon are indistinguishable from each other, and are the same at both electrodes. Cyanogen gives in the kathode glow the well-known blue and violet shaded bands, and at the same time the bands at the red end shaded the reverse way, but no trace of either the carbonic oxide or of the candle-flame spectrum in any part of the tube. The appearance of the positive column in all cases agrees well with Prof. Thomson's theory

that the light arises from the association of ions, and has its origin in the positive ions, which in elements having diatomic molecules probably have not the same constitution as those molecules, but in elements with monatomic molecules may, when deionised, at once reproduce such molecules. The kathode glow the author ascribes to fluorescence, the gas acting as a screen to the kathode rays, and its molecules responding to the stimulus without being themselves permanently affected. This opinion rests on the way in which the glow maps out the course of the kathode rays, and on the observation that the spectral lines of the glow are in most cases reversible, and therefore probably have their origin in unaltered molecules of the several gases. In conclusion, the study of the kathode glow suggests that the solar chromosphere and corona are a huge kathode glow.—On a soluble colloidal form of ferric and of other phosphates: W. J. **Sell**, F.R.S.—On the distribution and spectra of metallic vapours in electric sparks: H. **Ramage.**—On the variation with wave-length of the double refraction in strained glass: L. N. G. **Filon.**—On the reflection of sound: Rev. H. J. **Sharpe.**

February 1.—Dr. Baker, president, in the chair.—Free-living fresh-water New Zealand nematodes: N. A. **Cobb.** Four new species, all belonging to known genera, are described. The specimens were dredged from the lakes, at depths ranging from 200 feet to 1150 feet.—Some High Andine and Antarctic Umbelliferæ: A. W. **Hill.** The communication dealt with the genera Crantzia (Nutt.) and Azorella (Lmk.), which are widely distributed in the southern hemisphere.—On the relative amount of ionisation produced in air and hydrogen by Röntgen rays: R. K. **McClung.** The object of the experiments described in this paper was to determine, if possible, the cause of the great discrepancy which exists between the results obtained by various experimenters who have previously worked on this subject. The results obtained by the various investigators differ very widely from one another. Experiments were made with various Röntgen ray bulbs in order to see whether the source of the rays had any influence upon the relative amounts of ionisation, and it was found that the source of the rays influenced the result to a very marked degree. Quite large variations in the ratio of the ionisation in hydrogen to that in air were obtained according to the bulb used. As different bulbs, of course, give out rays of different quality, it is evident from the experiments that the ionisation in hydrogen as compared with that in air depends upon the type of rays used. Further experiments are at present in progress to determine to what extent this variation depends upon the state of the vacuum in the Röntgen ray bulb. These experiments are as yet quite incomplete, but the indications are that the relative ionisation in the two gases does depend to some extent on the pressure of the gas in the bulb. Further experiments are to be made on this subject.

Dublin

Royal Dublin Society, January 19.—Mr. S. Geoghegan in the chair.—Prof. A. W. **Conway** read a paper on the reflection of electric waves from a moving plane conductor.—Prof. J. A. **McClelland** read two papers, (1) on the emanation given off by radium, (2) the comparison of capacities in electrical work (an application of radio-active substances). The first of these two papers contains an account of experiments made to test whether the emanation given off by radium is charged or not. The emanation is carried into a partially exhausted vessel by a current of air, the vessel being insulated and joined to a sensitive electrometer. No charge was detected. The ionisation produced in the vessel by the emanation is measured, and it is shown that if each emanation particle had a charge equal to or greater than the charge on the gaseous ion, a measurable deflection must have been observed, otherwise the ionisation produced by each emanation particle must have been greater than what is possible. The conclusion is therefore that the emanation is not charged. The substance of the second paper is as follows:—A *very steady* current can be obtained between two plates, one of which is kept at a high potential, by placing between the plates a quantity of uranium nitrate. This small steady current is used to charge the capacities to be compared to a given potential measured by an electrometer, and the time of charging is accurately measured in each case. The two capacities are therefore compared by simply observing two intervals of time. Numbers are given to show the accuracy of the method and the wide range of capacities to which it is applicable. In particular it is shown that capacities as small as one micro-microforad can easily be detected and measured by this method.—Prof. G. A. J. Cole communicated a paper by Mr. J. R. **Kilroe** on soil separations by the centrifugal method.

Paris.

Academy of Sciences, February 8.—M. Mascart in the chair.—The general law of distribution of rays in band spectra: H. **Deslandres.** Since the spectra obtained with a concave grating are too feeble for the purpose of verifying the author's hypotheses, he has used a plane grating with an astronomical mirror of silvered glass of 2·5 metres focal distance. This arrangement has given all the bands of the second group of nitrogen excellently defined. The law of distribution deduced is that, in general, each band, expressed in vibration numbers, is divisible into series of connected rays, each series being such that the successive intervals are in arithmetical progression.—A new electrical device for extinguishing the high frequency arc: M. **d'Arsonval.** In the production of high frequency currents for therapeutical use it is necessary to prevent the formation of an arc between the spark gap. By the use of a subsidiary condenser this result is obtained very simply.—Protective arrangements for electrical machines supplying high frequency generators: MM. **d'Arsonval** and **Gaiffe.** Numerous cases of breakdown of transformers and coils used in the production of high frequency currents are common, and one possible cause of this is the return of waves from the spark gap to the transformer. An arrangement of condensers and resistances is described by which this effect is stopped without any loss of power.—The action of phenyl-magnesium bromide upon anthraquinone. Symmetrical γ-dihydroxyl-γ-diphenyl-dihydro-anthracene: A. **Haller** and A. **Guyot.** Anthraquinone reacts in the normal manner with the phenyl magnesium compound, but the yield of the carbinol is poor, on account of the slight solubility of the ketone in ether. On the mechanism of the transmission of the *n*-rays through wires of different substances: E. **Bichat.** The transmission of the *n*-rays by a wire is regarded as being analogous to the experiment in which light is transmitted from one end to the other of a curved glass tube, by successive reflections. In support of this view, experiments on wires of different materials show that the transmission only takes place if the material of the wire is transparent for these rays. Thus the effect is not produced by a wire of lead, but the rays are transmitted by wires of copper, aluminium and zinc, all of which have been shown to allow of the passage of the *n*-rays.—On the determination of the displacement of a battleship: J. A. **Normand.**—On the true value of the major axis of a cometary orbit when far removed from the sun, and the supposed hyberbolic character of the comet 1890 II.: Louis **Fabry.** The author interprets the calculations of M. Strömgren as leading to an elliptical orbit for the comet 1890 II.—Remarks on differential equations of which the general integral is an entire function: Émile **Borel.**—On certain θ-functions, and on some hyperelliptic surfaces to which they lead: M. **Traynard.**—On entire series with entire coefficients: M. **Fatou.**—On the zeros of a class of multiform transcendentals: Georges **Remoundos.**—On the flame spectra of the alkaline metals: C. **de Watteville.** Photographs of the spectra of lithium, sodium, and potassium show that the rays fall into two groups, those which are equally strong in all parts of the flame, and those which are more intense in the lower part of the flame, that is to say, in that portion which emits the Swan spectrum. It is found that the rays in the former class are those which belong to the principal series of the element considered, whilst those of the second group belong to the secondary series of rays. The differences of the spectra would appear to be due to thermal causes only.—On the function which represents the magnification of objects seen through a transparent cone: C. **Chabrié.**—On the magnetic effect of convection currents: C. **Gutton.** By means of the increase of luminosity of a phosphorescent screen it is possible to

demonstrate the magnetic effect of convection currents. This method is free from the experimental difficulties which arise from the use of astatic couples, but does not lend itself to quantitative measurements.—A new theory of influence machines: V. **Schaffers.**—On the relation which exists between sudden variations of the reluctance of a magnetised steel bar submitted to traction and the formation of Lüders's lines: L. **Fraichet.** During the time that new lines are being formed on the test piece, the variation of the reluctance is discontinuous, and when the variation of reluctance becomes continuous no new lines are observed.—Remarks on the subject of a note on osmosis by M. A. Guillemin: A. **Ponsot.**—On the use of the alternating current in electrolysis: André **Brochet** and Joseph **Petit.**—On the reduction phenomena produced by the action of alternating currents: F. **Pearce** and Ch. **Couchet.** Ferric alum is reduced nearly quantitatively by an alternating current when iron electrodes are used; alkaline nitrates are reduced to nitrites with electrodes of cadmium and zinc. The reduction of other inorganic salts is mentioned, and also the production of aniline from nitrobenzene.—The production of the sulphides of phosphorus in the cold: R. **Boulouch.**—Observations relating to the action of heat and light on mixtures of phosphorus sesquisulphide and sulphur in solution in carbon bisulphide: E. **Dervin.**—The action of carbonic acid upon solutions of sodium nitrite: C. **Marie** and R. **Marquis.** In opposition to the statements of M. Louis Meunier, the authors maintain that nitrous acid is set free by the action of carbon dioxide upon a solution of sodium nitrite.—On the constitution and properties of vanadium steels: Léon **Guillet.**—On the diureides: homoallantoic ether: L. J. **Simon.**—On the phosphoric esters of glycol: P. **Carré.**—On the nature of starch: L. **Maquenne.**—The biochemical synthesis of olein and some esters: Henri **Pottevin.**—The formation of turpene compounds in the chlorophyll organs: Eug. **Charabot** and Alex. **Hébert.**—On the presence of an oxidising-reducing diastase in plants: J. E. **Abelous** and J. **Aloy.**—The geographical distribution of the marine Bryozoa and the theory of bipolarity: L. **Calvet.**—The influence of temperature on the duration of the phases of indirect division: J. **Jolly.**—On the assimilation of alcohols and aldehydes by *Sterigmatocystis nigra*: Henri **Coupin.** Certain alcohols, such as ethyl alcohol, glycerol, and mannite can be assimilated by the moulds, others (methyl alcohol, glycol) are indifferent, whilst a third class (amyl, propyl, butyl) are toxic.—On a special function of the mycorhizome of the lateral roots of vanilla: H. Jacob **de Cordemoy.**—On the stratification of the Montagne Noire: J. **Bergeron.**—Geological observations in the neighbourhood of Thonon-les-Bains: H. **Douxami.**—*Palaeoblattina Douvillei*—an insect or a trilobite: M. **Agnus.**

DIARY OF SOCIETIES.

THURSDAY, FEBRUARY 18.

ROYAL SOCIETY, at 4.30.—Further Researches on the Temperature Classification of Stars: Sir J. Norman Lockyer, K.C.B., F.R.S.—Theory of Amphoteric Electrolytes: Prof. J. Walker, F.R.S.—Note on the Formation of Solids at Low Temperatures, particularly with regard to Solid Hydrogen: Prof. M. W. Travers.—Atmospherical Radio-activity in High Latitudes: G. C. Simpson.

ROYAL INSTITUTION, at 5.—Recent Research in Agriculture: A. D. Hall.

LINNEAN SOCIETY, at 8.—Mendel's Laws as Illustrated by Wheat Hybrids: R. H. Biffen. Heredity and Variation as seen in *Primula sinensis*: W. Bateson, F.R.S.—Formation of Secondary Wood in Psilotum: L. A. Boodle.

FRIDAY, FEBRUARY 19.

ROYAL INSTITUTION, at 9. Condensation Nuclei: C. T. R. Wilson, F.R.S.

GEOLOGICAL SOCIETY, at 8.—Anniversary Meeting.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—Annual General Meeting; followed by Discussion on Heat Treatment of Steel.—The Motion of Gases in Pipes and the Use of Gauges to Determine the Delivery: R. Threlfall, F.R.S.

EPIDEMIOLOGICAL SOCIETY, at 8.30.—The Etiology of Scurvy: Dr. Myer Coplans.

SATURDAY, FEBRUARY 20.

ROYAL INSTITUTION, at 3.—The Life and Work of Stokes: Lord Rayleigh.

MONDAY, FEBRUARY 22.

SOCIETY OF ARTS, at 8.—Modern Book Printing: Charles T. Jacobi.

SOCIETY OF CHEMICAL INDUSTRY, at 8.—Duty Free Alcohol: Thomas T. Tyrer.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—A Pioneer Expedition to Angola: Capt. Boyd A. Cuninghame.—A Journey in Northern Uganda: Major P. H. G. Powell-Cotton.

VICTORIA INSTITUTE, at 4.30.—Observations on the Irrigation of India: Charles W. Odling.

TUESDAY, FEBRUARY 23.

ROYAL INSTITUTION, at 5.—Japanese Life and Character: Prof. E. Foxwell.

ANTHROPOLOGICAL INSTITUTE, at 8.15.—The Fijians in Peace and War: W. L. Allardyce, C.M.G.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Construction of Railway-Wagons in Steel: J. D. Twinberrow.—The Construction of Iron and Steel Railway Wagons: A. L. Shackleford.—Iron and Steel Railway-Wagons of High Capacity: J. T. Jepson.

WEDNESDAY, FEBRUARY 24.

SOCIETY OF ARTS, at 8.—Mahogany and other Fancy Woods available for Constructive and Decorative Purposes: Frank Tiffany.

SOCIETY FOR THE PROTECTION OF BIRDS, at 3.—Annual Meeting.

GEOLOGICAL SOCIETY, at 8.—Eocene and Later Formations surrounding the Dardanelles: Lieut.-Col. Thomas English, with Appendices by Dr. John Smith Flett, R. Holland, and R. B. Newton.—The Derby Earthquakes of March 24 and May 3, 1903: Dr. C. Davison.

THURSDAY, FEBRUARY 25.

ROYAL SOCIETY, at 4.30.—*Probable Papers:* The Electromotive Phenomena in Mammalian Non-medullated Nerve: Dr. N. H. Alcock.—Further Observations on the *Rôle* of the Blood-Fluids in connection with Phagocytosis: Dr. A. E. Wright and Capt. S. R. Douglas.—A Contribution to the Pharmacology of Indian Cobra-venom: Major R. H. Elliot.

ROYAL INSTITUTION, at 5.—Electrical Methods of Measuring Temperature: Prof. H. L. Callendar, F.R.S.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Transatlantic Engineering Schools and Engineering: Dr. R. M. Walmsley. (Adjourned Discussion.)

FRIDAY, FEBRUARY 26.

ROYAL INSTITUTION, at 9.—New Developments in Electric Railways: Alex. Siemens.

PHYSICAL SOCIETY, at 5.

SATURDAY, FEBRUARY 27.

ROYAL INSTITUTION, at 3.—The Life and Work of Stokes: Lord Rayleigh.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Boiler-house Design: L. G. Crawford.

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THURSDAY, FEBRUARY 25, 1904.

HETEROGENESIS.

Studies in Heterogenesis. By H. Charlton Bastian, M.A., M.D., F.R.S. Pp. ix+354+xxxvii; 19 plates, with 815 illustrations from photomicrographs. (London: Williams and Norgate, 1903.) Price 31*s.* 6*d.*

HETEROGENESIS means, in these studies, the *per saltum* origin of forms of life from other quite different forms, *e.g.* of a ciliated infusorian from a rotifer's egg, or of a sun-animalcule from a chlorophyll corpuscle. It is long since Dr. H. Charlton Bastian first suggested this heresy; and many years of industrious observation have resulted in this large and expensive volume describing and (with 815 figures) illustrating those cases in which the author thinks he has detected the heterogenetic process at work. One cannot but admire the doggedness with which Dr. Bastian has persisted—*contra mundum*—in maintaining his thesis; and even those who feel quite sure that he has misinterpreted what he saw may find it interesting to discover by repetition of his experiments what did actually occur and was actually photographed. Others, again, who would not turn round to look at slides supposed to demonstrate that the egg of a rotifer may resolve itself into infusorians or into one large ciliate, may be more tolerant of the suggestion that Protistan evolution is still going on, retracing some of its ancient steps, or making new ones. It may be that Proteus still frisks a little among the Protists, or that there are mutations among unicellulars just as among De Vries's evening primroses.

It is often said by biologists that biogenesis (or the origin of approximately like from like) is not so much a law as a fact. It may not have always been, it may not everywhere be, that a living creature arises only from a parent or parents like itself; but, so far as our experience goes, the biologists say, there is no exception to this rule. Here, however, we have a book which is full of such exceptions, and yet the author's papers on this subject are rejected by the Royal Society of London, the Académie des Sciences of Paris, the K. Akademie der Wissenschaften of Berlin, and the R. Accademia dei Lincei of Rome! What does this mean? Does it mean more than that the author's rejected addresses appeared to the secretaries and committees of these learned bodies as incredible, as the recent facts and theories relating to radium would have seemed not long ago? "What can hardly be distinguished from perpetual motion, which it is an axiom of science to call impossible, has," says Prof. Boys, "left every chemist and physicist in a state of bewilderment." Thus, as the question rises in our minds, whether heterogenesis may not be an unknown factor in evolution, we turn to what Dr. Bastian has really done.

(1) The author believes that he has shown the *de novo* origin of bacteria within "closed cells," *e.g.* of fruits or in a structure like a caudal seta of Cyclops. In the last case, two or three days after death, "scarcely visible motionless specks gradually appear in the structureless protoplasm," they grow into bacteria and show active swarming movements. "In such a case it is clear that we have to do with no process of infection from without, but with a *de novo* origin of bacteria from the protoplasmic contents of the spines or setæ." But this interpretation is quite unnecessary; it has been shown beyond doubt that bacteria may exist in fluids where the highest powers of the microscope fail to detect them, many organisms normally swarm with bacteria, and the possibility of infection from without also remains.

(2) Another set of experiments, which appear to us of greater value, are concerned with the "proligerous pellicle" or zooglœa that forms on the surface of organic infusions. Apart from his conclusions, which means, of course, leaving Hamlet out of the play, Dr. Bastian's study of the surface pellicle, apparently a very hotbed of life, is a very interesting contribution to microbiology. From such a pellicle, which *seems* to consist solely of aggregates of bacteria, come fungus "germs," amœbæ, flagellate monads, and even ciliated infusorians like vorticellids. Some of the transformations are described and photographed from stage to stage, and a point is made of the diversity of results obtainable from similar pellicles. But, so far as we can see, no progress in proving heterogenesis can be made along this line. From what *seems* to be a homogeneous pellicle of discrete corpuscles there arise all sorts of animalcules, and Bastian argues in favour of heterogenesis because they were not there before; while to the majority of biologists the emergence of the amœbæ and infusorians simply proves that they *were*, in minute form, there before, or *were added to* the pellicle from above or from below in the course of the transformation.

It is a familiar fact that a small sample of water from a brook may show in many representative drops no evidence of living organisms of any kind, even when examined under very high magnification. But in this sample after a week or two there are not merely microbes, but monads, flagellates, and even ciliates. The enthusiast on behalf of heterogenesis concludes that the new tenants arose from ultra-microscopic animate particles or from non-living material; the ordinary humdrum biologist concludes that he overlooked in his sample the juvenile forms of the now obvious tenants, or that his expedients to avoid infection from without were insufficient. But, prejudice apart, it seems a little like a *non possumus* argument on both sides until we inquire into the familiar control experiments of boiling or otherwise sterilising the samples, and then the advocate of heterogenesis is forced to say that such cataclysmal operations as boiling prevented the inorganic potentialities from asserting themselves. This savours strongly of the explanation of a séance failure by the presence of sceptical spirits. It may be that in both cases the objection is valid, but when a full-fledged vorticellid emerges in the sample, or when the summoned spirit reveals an acquaintance with the canards of the daily Press, we fall back into utter scepticism in regard to both heterogenesis and spiritualistic séances.

(3) Many other heterogenetic modes of origin—of fungus "germs," of amœbæ, of monads, of Actino-

phrys, of Peranemata, and of diatoms—have been observed by Dr. Bastian. Thus he describes in detail how within the closed cells of sprigs of *Nitella opaca* multitudes of Actinophrys appear; "all the smallest specimens are of just the same size as the chlorophyll corpuscles," "none are to be found smaller than these corpuscles," they have at first no rays, and they are motionless. "The myriads of chlorophyll corpuscles are converted into the myriads of Actinophrys." That is to say, the corpuscles of a vegetable cell may be suddenly transformed into well-known Protozoa with a specific cytoplasmic and nuclear structure, a *per saltum* transformation which no biologist would believe even if he seemed to see it, for it suggests a magical evolution entirely beyond credence, because so meaningless. In the same way the author describes the origin of immature diatoms as heterogenetic products due to the transformation of the cells of the alga Chlorochytrium, parasitic in the duckweed. Of course, the author discusses other interpretations, the infection hypothesis, backed by a further hypothesis of chemotaxis, and shows at length that they do not fit the facts he has observed. It may be noted that we have a very imperfect acquaintance with the complete life-histories of most unicellular organisms, that there is probably an extraordinary complexity of symbiosis and commensalism amongst them, that many are known to be very modifiable or plastic; and it may be that Dr. Bastian's work will find its reward in provoking research to make our knowledge of unicellular organisms more continuous. On the other hand, it is well known that many forms carefully studied have a very definite and specific organisation, and we would believe many things—even that Dr. Bastian's carefulness of method was not all that could be desired—rather than accept the view that one type of cytoplasmic organisation can be suddenly transformed into another. Evidence in favour of a certain amount of heterogenesis many biologists would be prepared to consider carefully, but when it comes to a chlorophyll corpuscle changing into an Actinophrys, we are in the position, absolutely inevitable, of those who would not believe in a resurrection though one rose from the dead.

(4) The climax of Dr. Bastian's book is his account of the heterogenesis of ciliated infusorians. These relatively highly organised forms may arise, he says, from the pellicle on organic infusions, from the transformation of amœbæ, from encysted euglenæ, from the eggs of Tardigrada, and from the eggs of the rotifer, Hydatina. Let us confine ourselves to the last instance. It was found that the eggs of Hydatina may give rise in a few days to young forms of Vorticella, Oxytricha, *Aspidisca costata*, or to a large ciliate known as *Otostoma carteri*. Nine stages in the transformation of a fresh egg of Hydatina into an Otostoma are described, and the author says "however improbable this transformation may seem to those who have not studied the changes for themselves, the possibilities of error are still more improbable." Against the suggestion that he mistook encysted Otostoma for the rotifer's eggs, Bastian gives seven items of evidence; against the suggestion that each egg seeming to undergo the transformation in question, was infected by an immature form of the infusorian, he gives eight items of evidence. If we take for granted that Dr. Bastian made no mistake in identifying either the Hydatina eggs or the large Otostoma, we must conclude that he witnessed a remarkable phenomenon which should be re-studied and properly figured. Different stages should be treated by the usual histological methods, carefully drawn and compared with the normal course of development. Careful attention should also be paid to the numerous parasites of rotifers, *e.g.* those described by Przesmycki. The photographic method used by Bastian has its obvious value, but the results are very far from clear or convincing.

In an exceedingly interesting and acute chapter on the general subject of discontinuous or *per saltum* variation. Dr. Bastian points out that his general position is supported by analogies in the inorganic world, *e.g.* by the fact that many substances crystallise in forms which belong to two or three different systems of crystallisation, and that the difference of crystalline form which they exhibit is associated with difference of specific gravity, hardness, colour, and other properties. Then there is the case of radium, which "may be looked upon as continuously giving rise to new elements by a process of material evolution." He discusses cases of abrupt or transilient variation in animals and plants, and combats the opposition which Weismann expressed in his early "Studies in the Theory of Descent" to the idea of "sudden transformation of the whole organism." But Weismann's views have changed not a little since 1882, and it would have been fairer to have quoted from his "Vorträge" of 1902. Dr. Bastian does not seem to have quite realised how many biologists now accept, as proved up to the hilt, the frequent occurrence of Galton's "transilient," or Bateson's "discontinuous," or De Vries's "mutational" variations. But this is not quite the same thing as accepting the observational conclusion that the chlorophyll corpuscle of Nitella may become a sun-animalcule, or a rotifer's egg a large ciliate! There are some things that one must see for oneself, and even then one would not believe them! It may be that "the lowest organisms exist at the present day because they are ever seething up anew by processes of heterogenesis"; and we should not be greatly surprised if that turned out to be a thesis "founded upon fact and consistent with reason." But such an epoch-making conclusion must be proved, not by one prejudiced in its favour, but by a man of *thätige Skepsis*, who takes every possible precaution to avoid discovering heterogenesis, who will certainly not adduce as evidence cases of a rotifer's germ-plasm demeaning itself to reincarnation as a ciliated infusorian. The author was forced, indeed, to offer the evidence that he observed, but if he had not drawn his bow quite so far as the case just cited implies, the arrow with "heterogenesis" on its feather might have penetrated further.

Very useful, it seems to us, is the author's idea of "ephemeromorphs," that is, of transitorily occurring phases among unicellulars, which may be wholly due to modificational influence, in contradistinction to the

regularly recurrent stable forms which constitute a species. We are inclined to think that this idea, extended to the study of multicellular forms, would show that many so-called species are based on transient "modificational" ephemeromorphs.

There is a dignified candour in Dr. Bastian's attitude towards sceptics. "It will doubtless be said that the facts I have brought forward are mere figments of my imagination, seeing that others observe no such phenomena, and that my experience is altogether exceptional." To this he answers (1) that many recorded phenomena, referred without proof to infection by parasites, are more simply interpretable as heterogenetic; (2) that he has seen the numerous cases he has recorded because he has diligently looked for them through many years; and (3) that, after all, his photographs of transformations have to be explained somehow. We must confess that the photographs, "engraved and printed," appear to us no more than a plethora of puzzles and futilities of delineation. The method is obviously admirable in being impersonal, but it seems to us quite ineffective in showing the transformation of the rotifer's or tardigrade's ova into infusorians. But we can only state our own impression; others may see more in them than we can detect; perhaps the eye of faith will see much.

"Some of my critics have refused to give any adequate consideration to the work because it has not been entirely done under certain impossible conditions which they would prescribe." Dr. Bastian admits that he has not uniformly isolated the organisms under process of change or placed them in a sterilised medium. Such cataclysmal interference would inevitably stop the heterogenetic progress. He declares, however, that the observations in proof of the heterogenetic origin of bacteria and their allies "have been conducted with all necessary precautions against the possibility of infection." If so, and every experimenter will agree that it is a big "if," then the bacteria did arise by heterogenesis, *or* they were present, though unseen, from the first. To the critic who asks why Dr. Bastian did not continuously watch the alleged heterogenetic changes from start to finish on the same individual organism, it is answered that the method pursued was that usually followed in embryological research—that of observing different states of change in different individuals. The method is comparable to that of palæontologists in working out a presumed series of phyletic change; it is not absolutely demonstrative, but it reveals phenomena which must be interpreted somehow; and the best and most reasonable interpretation, "as much as possible irrespective of preconceptions and *a priori* views," seems to the author that of heterogenesis. If it be urged that Dr. Bastian should have watched the heterogenetic processes he believes in with the same sort of assiduous continuity as Dallinger and Drysdale achieved in studying their plastic monads, it is answered that "compliance with such demands would not only be fruitless but would go far to render for ever impossible any knowledge of heterogenesis." Why this should be so we do not understand, unless heterogenesis be like the building of the fairies' palace which always stopped if anyone looked at it. But the fact is that "the methods employed by those who would gain a knowledge of heterogenesis cannot, from the very nature of the subject, be strict laboratory methods"—and this, we fear, will foreclose the question in the eyes of most biologists.

For our part, the suggestion of foreclosing a question like this savours of prejudice, and it should be remembered that results of great value, both theoretically and practically, have issued from the long drawn out controversy over spontaneous generation. After a careful study of Dr. Bastian's book, we venture to sum up our impressions as follows:—(1) If the idea of heterogenesis means, when generalised, that there may be marked discontinuity, or transilience, or *per saltum* change in the ceaseless process of organic variation, then we side with the author, and in this regard he will find that he has many allies. (2) In so far as the idea of heterogenesis implies that many of the lowest forms of life are very plastic creatures of circumstance, capable of passing from phase to phase of the cell-cycle under modificational stimulus, so markedly that they may be called "ephemeromorphs," we again side with the author, for we think that there are many facts which point in this direction. (3) As to the thesis that simple organisms "are ever seething up anew by processes of heterogenesis," it seems to us, in our ignorance, a quite legitimate conception which may eventually be demonstrated as true. (4) But as to the majority of the cases of heterogenesis which Dr. Bastian adduces, we cannot but reject them as inconclusive, not only because the methods employed seem to us to be fallacious, especially in depreciating the possibilities of latent germs and of infection; not only because they lead us to conclusions which we cannot harmonise with our confessedly incomplete biological system; but especially because they are so *meaningless*. If the egg of the Hydatina can, "under conditions not always easy to realise," be transformed into a large ciliated infusorian, then our *Systema Naturae* is a farce.

J. A. T.

PROF. OSTWALD'S JUBILEE.

Jubelband—Wilhelm Ostwald. Gewidmet zur Feier seiner vor fünfundzwanzig Jahren erfolgter Doktorpromotion von seinen Schülern, mit einer Einleitung von J. H. van 't Hoff. Pp. xxxi+679. (*Zeitschrift für physikalische Chemie*, Band 46.)

THIS stately volume is a fitting tribute to an eminent man who has done much to advance the progress of modern chemistry. The triumvirate, van 't Hoff, Arrhenius and Ostwald, the Dutchman, the Swede and the Russo-German, had a hard battle before their doctrines were accepted by physicists and by chemists. The communications made in the first volume of Ostwald's *Zeitschrift* by van 't Hoff (p. 481) on the *rôle* of osmotic pressure in the analogy between liquids

and gases, and by Arrhenius (p. 631) on the dissociation of substances dissolved in water, brought together the three friends in a manner which we now recognise as almost dramatic. Of Ostwald's 147 pupils, 34 of whom are now professors in universities all over the world, 34 have contributed memoirs to the "Jubelband" in honour of their teacher.

It would be impossible in the limited space of this notice to give an account of the contents of these articles, and it would be invidious to select names and tedious to mention all. Suffice it to say that the memoirs are in French, English and German; that their authors write from Germany, Russia, Finland, Sweden, Austria, Belgium, Greece, England, Scotland and Ireland; and that they are often under two names, implying that a third generation has aided in the research. The subjects of the memoirs range over a wide field; papers relating to solubility, to electric discharge, to electric conductivity, to vapour-pressures, to crystallisation, to catalysis, to capillarity, to high temperature reactions, to stereochemistry, to phase-rule phenomena, to colloids, to critical phenomena, to polarisation phenomena, all are found in this volume, and it is certain that each and all of the authors would acknowledge that their inspiration was derived in great part from their master, Ostwald.

A list is given of Ostwald's publications. The colossal labour of collecting and coordinating all known facts bearing on general chemistry is shown by the fact that the "Lehrbuch der allgemeinen Chemie," begun in 1885 and ended in 1887, required a new edition in 1891, which, indeed, is not yet quite complete; that, in addition to this *magnum opus*, a "Grundriss" was published in 1889; that volumes on "Physicochemical Measurements" (1893), "The Scientific Foundations of Analytical Chemistry" (1894), "Electrochemistry" (1896), "Outlines of Inorganic Chemistry" (1900), "Lectures on Philosophy" (1902) and "Chemical Dialogues" ("Die Schule der Chemie") (1903) have all proceeded from Ostwald's facile pen; and that translations of many of these works have appeared in English, Russian, French, Polish, Czech and Japanese. Besides these original works Ostwald has edited and annotated since 1889 selections from the works of Dalton, Wollaston, Gay-Lussac, Avogadro and Ampère, Hess, Hittorf, Wilhelmy, Bunsen and Roscoe, Berzelius, Carnot, Dulong and Petit, Davy, Scheele, Kirchhoff and Bunsen, and Berthollet, in the series of "Classics of Exact Science"; he has edited, along with van 't Hoff, the *Zeitschrift für physikalische Chemie* since 1887, of which 45 volumes have now appeared (it is to be presumed that the editorship of this, the forty-sixth, was not carried out by him); and since 1875 he has published no fewer than 120 papers and memoirs, embodying in large measure the results of his own researches; lastly, he has contributed about 3880 abstracts of papers and 890 reviews of books to the Zeitschrift which goes by his name.

One may well ask, how was it done? Those who know Ostwald will still be amazed; but they will recall to their minds that he possesses a rapidity of thought, an extraordinarily retentive memory, an astounding diligence and a pen which moves without effort; and perhaps most important of all, the power of expressing his ideas and those of others in clear language. Indeed, it may almost be said that Ostwald has imparted to German the accuracy and lucidity of French.

The volume contains an excellent portrait of Ostwald at his desk, and van 't Hoff prefaces the contents by a short biography, from which we learn that he was born in 1853 in Riga, that he was there as schoolboy, student, assistant, "privat-docent" and professor, until, in 1887, he was called to fill the chair of physical chemistry in Leipzig, a position which he still holds. Van 't Hoff also sketches Ostwald as a teacher, an investigator, an organiser and a reformer, and traces his progress in research from his earliest work on "The Mass-action of Water" to his latest work on the "Philosophy of Nature." The gap may appear a wide one, where only the two ends of the curve are given; but it is a continuous curve, and one which abundantly testifies to the "Stetigkeit," or continuity, of natural phenomena. Ostwald's missionary zeal is also pourtrayed.

"He is not content in gaining a view for himself; it is perhaps with him a necessity to impregnate others with his thoughts, and this has doubtless largely contributed to the present-day position of physical chemistry. The spreading of his ideas abroad runs parallel with his own activity in research and original thought."

Again :—

"In Ostwald as organiser we admire the practical man, who sees clearly what can be done, in small as well as in great things. On the small scale he is the constructor and deviser of handy apparatus, which he himself enjoys making, and the contriver of convenient methods of work. . . . On the large scale, he carries this sense of the practical to the erection of a pattern laboratory in the new institute at Leipzig, dedicated chiefly to physical chemistry, and embodying the many-sided mind of the master."

And in picturing another side of Ostwald's character, van 't Hoff writes regarding the work of Arrhenius (and though modesty forbids him to mention it, of himself) :

"How often do we see in similar cases an estrangement! With Ostwald, however, the opposite; sympathetic cooperation, in which Nernst soon joined as a partner."

Lastly, in dealing with Ostwald's many-sidedness, for example, in founding the Bunsen Society for Electrochemistry and editing the *Annalen der Naturphilosophie* :—

"The astonishing thing, when we consider Ostwald's activity, ever extending to wider and wider circles, is that neither his interest in his former sphere of work nor his mastery over it lessens."

Fortunate they who have been Ostwald's students; and happy they who possess his friendship!

JAPANESE BOTANY.

New Lessons in Elementary Botany (*Saishin Shokubutsugakkô Kwasho*). By Itô Tokutarô, Rigaku Hakushi, D.Sc., F.L.S.

OF this well got up, well illustrated, and lucidly written elementary treatise on botany the following translation of the introductory chapter or preface will give an adequate general idea.

It describes the province of botany in a manner likely to interest a young Japanese student.

"The surface of the globe we live on is covered with a varied and abundant vegetation, differing and agreeing in accordance with differences and likenesses of soil and climate. In this Japan of ours, which is a land within the temperate zone, many and beautiful are the flowers of the wild plants that blow at the various seasons of the year. In spring we have the *sakura* (wild cherry), the *yamabuki* (Kerria), the *tsutsuji* (azalea), the *fuji* (wistaria); in summer the *Ayame* (iris), the *kakitsubata* (*Iris laevigata?*), the *yuri* (lily); in autumn the *hagi* (Lespedeza), the kikyô (Platycodon), the *ominameshi* (Patrinia); in winter the *tsubaki* (Camellia), *sazankwa* (mountain tea-flower) and the *fukujyusô* (*Adonis amurensis*).

"Among cultivated plants we have the *ume* (plum), *momo* (peach), *Kaidô* (*Pyrus spectabilis*), *botan* (peony), *shakuyaku* (*Paeonia albiflora*), *asagaho* (morning glory), *fuyô* (*Hibiscus mutabilis*) and *kiku* (chrysanth).

"On the hill slopes grow the *matsu* (Pinus), *sugi* (Cryptomeria), *hinoki* (Chamæcyparis), *keyaki* (*Zelkowa acuminata*, *yenoki* (*Celtis sinensis*), *Kashi* (oak), *shii* (*Q. cuspidata*), and other trees. On the wastes and moors we find *sumire* (*Viola Patrinii*), *tampopo* (*Taraxacum corniculatum*), *rengesô* (*Astragalus lotoides*), &c., among spring plants; among autumn ones, in addition to those named before, *fujibakama* (*Eupatorium chinense*), *susuki* (*Eulalia japonica*), and others, in such abundance as to form a many coloured carpet varying according to the season spread over the land.

"In the fields and paddies grow rice, wheat, Indian corn, colza and raphanus under cultivation, the scene being diversified by scattered clumps of dark green bamboo groves. Then in the neighbourhood of temples and shrines are camphor laurels and *ichô* trees (*Gingko biloba*)—the camphor laurels are found indigenous only in China and Japan, but are cultivated elsewhere. The *ichô* is fairly common with us, and therefore not considered a curiosity, but abroad (with the exception of China) no tree resembling it is found —it is unique.

"Again, in ponds, swamps, lakes, and rivers we have *kawahone* (*Nuphar japonicum*), *jyunsai* (*Brasenia peltata*), *hishi* (*Trapa bispinosa*), *ukikusa* (*Lemna minor*), &c., and in the sea *arame* (Ecklonia?), *wakame* (*Alaria pinnatifida*), *kombu* (*Laminaria japonica*), *asakusanori* (a kind of laver), &c.

"On our high mountains only grow such plants as *kokemomo* (Vaccinium sp.), *ihôme* (Blyxa sp.?), *gankôran* (*Empetrum nigrum*), &c., also such plants as *yashi* (*Cocos nucifera*, but this may be a mistake), *hego* (sp. of tree fern Cyathea), &c., of Asiatic and Malayan character, others of Mexican and American affinities, such as *saboten* (cactus), *riuzetsuran* (various parasitic orchids), &c., even Australian forms, such as Acacia and Eucalyptus (but these, of course, introduced).

"Our indigenous species of trees, shrubs and herbs, including cryptogams, are very numerous; in addition, among botanical forms we must count the innumerable microscopic organisms found in a drop of water or in mouldy rice.

"Some 140 years ago scarcely 10,000 species (of phanerogams and cryptogams?) were known to science; now more than 175,000 are known to flourish on our globe, and to be thus denizens of the province of botany."

The illustrations are extremely good, and many of them apparently original. Among the best are those of the hydrangea (*ajisai*), *Vicia faba* (*soramame*), the fruit of chestnut (*Kuri*), section of plum-fruit, wood of wild cherry and of *shuro* (Trachycarpus), the figure of a potato plant (*jagatara-imo*), dissection of iris flower, mistletoe on Celtis, &c. There are, in addition, two very finely coloured plates, both of gorges among the Nikko Hills, one—the frontispiece—showing, ingeniously enough, on its guard-fly leaf the outline figures with the names of the principal plants in the rich mass depicted in the chromo. Unfortunately, of the Japanese names given, only one or two can be identified in any books at my command. It is worth notice how large a proportion of the names of even common plants is Chinese.

Dr. Itô may be congratulated on the production of so excellent, indeed charming, an introduction to the study of that most fascinating of sciences, botany.[1]

F. VICTOR DICKINS.

[1] I am not sure of the accuracy of the above given botanical equivalents.

OUR UNIQUE EARTH!

Man's Place in the Universe. By Alfred R. Wallace, LL.D., D.C.L., F.R.S., &c. Pp. xi+330. (London: Chapman and Hall, Ltd., 1903.) Price 12s. 6d.

A BOOK from the pen of so distinguished a man as Dr. Alfred Russel Wallace would naturally find many readers, but the present volume, dealing with a subject of such general interest, will undoubtedly be widely distributed.

This work is the outcome of an article which Dr. Wallace published some time ago, and the interest it excited spurred him on to bring together in book form in a more elaborate and detailed manner the arguments on which the subject-matter was based.

The reader, therefore, has now before him the whole of the evidence upon which the author claims certain conclusions, which have "enormous probabilities in their favour," namely, "that no other planet in the solar system than our earth is inhabited or habitable," "that the probabilities are almost as great against any other sun possessing inhabited planets," and "that the nearly central position of our sun is probably a permanent one, and has been specially favourable,

perhaps absolutely essential, to life-development on the earth."

A close perusal of the subject-matter indicates, in the first place, two prominent facts. First, the masterly way in which Dr. Wallace has marshalled the available subject-matter to enforce his lines of argument, and second, the excessively clear and concise summary of the astronomical knowledge which he has employed. This latter is contained in the first six chapters, and although the author suggests that those who are fairly acquainted with modern astronomical literature might omit reading these, the account is so excellent that the advice should not be followed.

It is not the object of this review to tell our readers whether Dr. Wallace is correct or not in the conclusions at which he has arrived, for that would not be an easy matter, but to direct attention to a work which must be treated with considerable respect.

Astronomical science has, during the last thirty years, made enormous strides, but the information that is needed when considering such a problem as is dealt with by Dr. Wallace is still very sparse, and is conspicuously absent from many books which by their titles ought to contain it.

Chapters vii. to ix. deal with the problems, Are the stars infinite in number? our relation to the Milky Way; and the uniformity of matter and its laws throughout the stellar universe. In all of these the author displays a very thorough acquaintance with the recent advances in these subjects. He concludes from such evidence that the stellar universe is limited, that the solar system is nearly in a central position of the Milky Way, this position being probably a permanent one, and, lastly, that the whole material universe is one as regards physical and chemical laws and material structure.

In the next chapter he sums up the essential characters of the living organism in a remarkably clear and definite manner, and points out the intimate connection between animal and vegetable life.

The chapter which follows describes all the physical conditions essential for this organic life, and then the four subsequent ones point out how these conditions, in his opinion, exist only on one planet, our earth, in the solar system. Not only does he suggest that the earth alone is inhabited, but that the other planets of the system have never been and never will be the seat of organic life, since they never can produce the exact conditions that are considered necessary.

The next and last chapter carries the argument into the starry realm beyond the solar system, and here the author gives his reasons for concluding that only a very few of these stars may be suns with life-supporting planets.

In considering man's place in the universe it seems that the matter dealt with in chapter x., in which the author describes the essential characters of the living organism, contains the criterion on which the whole question of the habitability of other worlds turns.

It is known that protoplasm is so complex chemically that it defies analysis, and protoplasm, to use Dr. Wallace's words, "is, as it were, only the starting point or material out of which the infinitely varied structures of living beings are formed. The extreme mobility and changeability of the structure of these molecules enable the protoplasm to be continually modified both in constitution and form, and, by the substitution or addition of other elements, to serve special purposes."

May it not be that the very complex nature of protoplasm and its very property, the ease with which it may be modified, enable it to adapt itself to the various conditions, such as distance from central orb, size, &c., that exist on the different planets at those epochs in their life's history when the temperature conditions are within the prescribed limits?

Might not this element of living matter, working under somewhat different conditions, so affect the after products that they in their turn could weather the existing conditions, which to them would be natural and to us special?

To consider this earth as the only inhabited body in the stellar universe, a reversion to prehistoric ideas, may or may not be an advance, but it will require very strong arguments before man can be brought to consider that his isolation in the cosmos is indeed a fact.

The book, however, is one that should be read by all those interested in such a speculation, for speculation at the present time it can only be, and much valuable information may be learnt about the various subjects which the author has had to deal with in his broad survey.

OUR BOOK SHELF.

The Fauna of British India, including Ceylon and Burma. Published under the authority of the Secretary of State for India in Council. Edited by W. T. Blanford. Rhynchota. Vol. ii. Part. i. (Heteroptera). By W. L. Distant. Pp. x+242. (London: Taylor and Francis, 1903.) Price 10s.

MR. DISTANT is making good progress with the description of the known species of Indian Rhynchota, and the editor informs us in his preface that the remainder of the volume will comprise all, or nearly all, the remaining families of the division Gymnocerata, thus leaving the bulk of the water-bugs for a third volume, which will complete the subject as far as the Heteroptera are concerned. The present instalment includes 371 species belonging to the families Lygæidæ, Pyrrhocoridæ, Tingididæ, Phymatidæ, Arœdidæ, Hebridæ, Hydrometridæ, Henicocephalidæ, and the commencement of the Reduviidæ. The letterpress is executed in the same careful manner as in the first volume, and is illustrated by 167 excellent text illustrations.

A considerable number of new species are described in the present part, and a very large proportion of the remainder have only become known to entomologists within the last few years, many of them, indeed, having been described by Mr. Distant, or others, as late as 1903. When we consider that the Hemiptera have been far from exhaustively collected at present, and that many of the families include small plant-feeding species, it will be plain that a vast amount of work still requires to be done before our knowledge of the Indian species can be considered as anything like complete. But such works as Mr. Distant's cannot but give a vast impetus to the study, while those who know its extent will not be liable to repeat the amusing error of Lich-

tenstein, who wrote in vol. vi. of the Linnean *Transactions*, about a century ago, that before he knew Fabricius personally, he thought the latter had been disrespectful to Linné and his other predecessors because he wrote that very little was known of entomology at that time, and that the study, especially as compared with botany, was still quite in its infancy.

Our own conception of present and future progress is doubtless equally imperfect, and it has been well said that no race of mankind is permitted to anticipate the prerogatives of its successors. To our grandfathers and great-grandfathers the very idea of carriages going without horses seemed ridiculous, and the mere suggestion of the wonderful discoveries of the last half-century would have been regarded a hundred years ago as the ravings of a lunatic.

A New Geometry for Junior Forms. By S. Barnard, M.A., and J. M. Child, B.A. Pp. vii+306. (London: Macmillan and Co., Ltd., 1904.) Price 2*s*. 6*d*.

This work is a selection from the larger work of Messrs. Barnard and Child published a few months ago. It is, of course, on the modern lines of teaching now almost universally adopted in England. There is no necessity for entering into a detailed account of the contents of the book, for the order and method of treatment are the same as those of the larger volume, which has already been highly commended in these columns. The work is simple, very thorough, and in every way suited to the requirements of junior students.

Although employing instruments and devoting much space to "practical" work at the outset, the authors never lose sight of the fundamental fact that *geometry is a science of strict logic*. Even those reformers of geometrical teaching who have done most to break with the difficult and stilted formalism of Euclid are sometimes alarmed by the methods adopted by the expounders of "practical mathematics"—methods entirely reprehensible because of their ignoring the logical foundations of science. The fact is that the teaching of modern improvements should be in the hands of skilled experts who have a commanding knowledge of scientific methods and results, and who are able to simplify matters for the student without sacrificing any portion of logical reasoning. We must take care that mere manual work, mechanical processes, and slipshod reasoning do not undermine the principles of accurate thought either in pure or in applied mathematics. So far, the works on geometry which give expression to the principles of the British and Mathematical Associations are beyond suspicion. The danger—though by no means absent from pure mathematics—is certainly greatest in physics and applied mathematics.

Fragments from Continental Journeyings. By A. R. Sennett. Pp. vi+516. (London: Whittaker and Co., 1903.) Price 4*s*. 6*d*. net.

We have all done it; R. L. Stevenson with a prose fancy that would elevate road-metal itself to a place among the humanities; Henry James with a just delicacy, that seems to add a decorative touch to the familiar châteaux and the well-worn ways; the rest of us, in this latter time, at a long distance and in various measure, yet drawn irresistibly into print. And now Mr. (or Miss?) A. R. Sennett is moved also to attempt to give to others some of the abiding pleasure experienced on the open road.

We have doubts as to the writer's sex, mainly on account of the references to female costume at Monte Carlo; the male author, moreover, is usually more circumspect in revealing his ignorance of foreign languages. This little book is crowded with inaccuracies in French and German, in fact, even the single words printed in italics are frequently incorrect. Names, which can be found on the maps in the library of the Automobile Club, are also occasionally misspelt. Hence we can hardly treat the work as a contribution to geography. The ground covered is that dealt with by the post-chaise travellers of the early nineteenth century, when the close of the great wars again allowed of observation. The frontispiece of Grindelwald and the Wetterhorn gives sufficient clue to the scope of the book as a record of continental journeyings. We have no right in this place to deal with it from a literary point of view; nor do we think that the author would welcome the remarks which we reserve. G. A. J. C.

Recueil d'Expériences élémentaires de Physique. First part. By Henri Abraham. Pp. xii+247. (Paris: Gauthier-Villars, 1904.) Price 5 francs.

This volume of less than three hundred pages has been produced with the collaboration of 154 physicists from all parts of the world!

The book is the outcome of a request made primarily to the members of the French Physical Society by its secretary, with the authority of its council, that they should aid in the production of a volume describing elementary experiments in physics by forwarding an account of any special experiments forming part of their laboratory courses. M. Abraham is editing these, and this is the first part of the result—a second part is to follow.

The descriptions of the experiments are not accompanied by theory. The only incursion into the domain of theory has been to direct the reader's attention to the degree of precision possible in each measurement, and to the need or uselessness, as the case might be, of introducing corrections.

On the other hand, great attention has been paid to describing the arrangement of the experiments; for example, all necessary sizes are specified in order that they may be reproduced as easily as possible.

No attempt has been made to unify the style of the very various methods which the author selected from; on the contrary, the desire has been to present as great a variety as possible.

The first chapter consists of elementary instruction in workshop practice (including glass-blowing), and has an appendix containing many useful receipts. The second is on geometry and mechanics, the third is on hydrostatics, hydrodynamics and capillarity; the fourth chapter deals with heat.

The experiments described are, in the majority of cases, of a very simple character, less suitable for colleges than for schools, where they should be very welcome. Many of them, indeed, are arranged as they might be by an amateur at home, and the instructions are certainly simple enough for a lad with mechanical and experimental tastes to derive a large amount of useful pleasure in carrying them out without the aid of a teacher.

Cassell's Popular Science. Edited by Alexander S. Galt. Volume ii. Pp. xii+556. (London: Cassell and Co., Ltd., 1904.)

This attractive volume, with its numerous excellent illustrations and its clear type, is calculated to create interest in the study of science. The editor has arranged matters in such a manner that most branches of natural knowledge are drawn upon to provide interesting reading. The first six articles, for example, deal with subjects belonging to physics, biology, astronomy and geology—and the reader's attention is certainly not kept upon one subject for too long at one time.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

Cancer and Parthenogenesis.

MAY I be allowed to refer to the interesting and stimulating discoveries of Messrs. Farmer, Moore and Walker, and Drs. Bashford and Murray? The former have demonstrated that nuclear changes occur in cancerous tissues, by which cells of malignant growths may be justly considered homologous to active sexual elements ("gametoid"). Giant cells are suggested to be "fusion-figures" which recall normal fertilisation (*sic*) in cancer.

I write to ask if botanists or zoologists are of the opinion that "post-heterotypic" cells (homotypic) are "inclined" at all to develop without fertilisation by the spermatozoon (*i.e.* by parthenogenesis from ? chemical stimulus).

Does parthenogenesis occur in the embryosac of flowering plants or in the prothallium of the higher cryptogams under any and what conditions?

On what known states does parthenogenesis in the eggs of the honey bee, in ascaris, in artemisia, &c., depend?

This sexual character of the cells of cancer explains partly its parasitic and invading nature; the wonderful power of mimicry of the tissues from which they originate suggests that metastases commence as cells self-fertilised and maturating. A knowledge of the (? chemical) causes underlying both these changes might afford a clue to prevention.

F. BUSHNELL.

S. Devon Hospital and Public Dispensary, Plymouth.

IN reply to the queries contained in the letter of Dr. Bushnell, it may at once be said that parthenogenesis is known to follow the application of certain stimuli in the case of a few animals and plants, Loeb's experiments on sea-urchins and Nathansohn's observations on Marsilea furnishing instances to the point.

Parthenogenesis occurs in the embryosac of species of Alchemilla, perhaps also in some species of figs, but the underlying conditions are not yet understood.

In other examples of parthenogenesis, as noted in animals, it arises in consequence of the lack of separation of the second polar body from the egg, or follows on the re-fusion of it with the egg. This represents, perhaps, a modified kind of fertilisation. Apogamy as occurring in ferns is a more remote event, but is apparently possessed of a similar significance.

I quite agree with Dr. Bushnell as to the importance of reaching an understanding of the chemical and other agencies that produce the change in cells previously normal, and the concluding paragraph of the article to which he refers emphasises this side of the subject.

J. B. FARMER.

Magdalen College, Oxford, February 13.

On a Dynamical System illustrating the Spectrum Lines and the Phenomena of Radio-activity.

BY the study of a system of particles, which is similar to a Saturnian system, I was led to the discussion of disturbances which propagate in the system, having close analogy with the band and line spectra while illustrating the phenomena of radio-activity. The system consists of a large number of particles of equal mass arranged in a circle at equal angular intervals, and repelling each other with forces inversely proportional to the square of distance between the particles; at the centre of the circle is placed a large particle attracting the other particles forming the ring according to the same law of force. If the repelling particles be revolving about the attracting centre, the system will generally remain stable for small oscillations, which consist of the transversal vibration perpendicular to the plane of the orbit, together with the radial and angular disturbances representing the rarefaction and condensation in the distribution of the particles. Small oscillations of this kind have already been treated by Maxwell in his essay on the stability of Saturn's rings; the system will be the same if the repelling particles of the present system be substituted by the attracting satellites. Evidently the system here considered will be approximately realised if we place negative electrons in the ring and a positive charge at the centre. Such an ideal atom will not be contradictory to the results of recent experiments on kathode rays, radio-activity, and other allied phenomena.

The frequency of the transversal vibration is given by

$$n=\omega-am^2+bm^4+\ .\ .\ .\ .,$$

where ω is the principal term and m the whole number. Plotting the lines of frequency, we find the crowding of lines when the value of m is small and when it is large. Generally the coefficient $a>0$, so that with increasing m the frequency decreases, and the interval between the lines becomes wider. The distribution of lines resembles that of a band spectrum proceeding from violet towards the red. Taking the converging point of the lines for large values of m as the beginning, it is convenient to count the lines from the point, which I suppose to correspond to $m=m_0$. Then putting

$$m=m_0-m'$$

we obtain, remembering that $\delta n=0$ for $m=m_0$,

$$n=\omega'+a'm'^2+b'm'^3+\ .\ .\ .\ .$$

n increases with m', and the distribution resembles the band spectrum of carbon type, the interval between the lines gradually widening from red towards the violet. In fact, the above equation is an extension of Deslandres's formula.

If we suppose that the particles are negative electrons, we can easily prove that the transversal vibration will not be sensibly affected by the external magnetic field. This is another characteristic of the band spectrum.

The radial and angular waves propagating round the ring have frequencies given by

$$n=\frac{C}{\sqrt{1-Am^2+Bm^4+\ .\ .\ .}}$$

The distribution of lines is such that they crowd together for tolerably large values of m towards a region of high frequency, and is in its general aspect similar to a band spectrum, with the difference that the interval between the successive lines is about nine times wider than in the band spectrum above described. This we may identify with the line spectrum, although m is not the same as in the formula of Kayser and Runge, or of Rydberg. The supposition that the particles are electrons leads to the conclusion that a single line is separated into doublets, circularly polarised in opposite senses.

The ring here considered is quasi-stable. It may be set to disturbances the radial and angular components of which are nearly proportional to

$$e^{\kappa\nu t},$$

where κ is a constant, ν the number of particles in a ring, and t the time. If the disturbance continues for a sufficiently long time, the ring will be torn asunder and the system will fly off with great velocity. If the particles are electrons, those in the ring will give rise to β rays, and the central positive charges will form the α rays.

The ideal atom here considered will have high atomic weight when ν is large; consequently the instability is easier to produce when the atom is massive. Where there are several series of regular spectra we shall have to consider different rings of particles giving rise to these different sets. The complexity of spectrum is by no means a guarantee for the heaviness of atom; on the contrary, if high atomic weight is accompanied with comparatively simple spectral structure, we may consider that the system of rings is less complex, and ν may be quite a large quantity. This probably accounts for the remarkable radio-active property of radium, which, in spite of its high atomic weight, presents only a certain number of characteristic spectrum lines.

The kinetics of the system here considered may be extended to investigations which have analogies with the flutings of spectrum lines. Considered as electrons, the phenomena of actino-electricity, the ionisation of flames, the change of resistance of semi-insulators by exposure to light, the problem of coherer, the phenomena of fluorescence and

phosphorescence, and many allied subjects will probably be accounted for by the discussion of resonance and forced oscillations, to which the system is susceptible.

The above results were communicated to the Physico-mathematical Society of Tokyo in December last; the details of calculation will probably appear in the *Philosophical Magazine* in the near future. H. NAGAOKA.

Physical Laboratory, Tokyo University, January 18.

Science in the Navy.

IN view of the important articles which appeared in NATURE last year on the question of science in the navy, it seems desirable to inquire into the amount of encouragement which is now given to young lieutenants to adopt either of the more scientific branches of their profession.

Apart from zeal for the service and the love of knowledge, the most potent incentive to their doing so lies in the promise of early promotion to commander. Now, of the thirty-five lieutenants promoted on January 1 last, the following analysis will show that the more scientific officer has no advantage over his fellow as regards promotion. The periods between promotion to lieutenant and to commander were:—

	12	Lieutenants of the general service	10·8 years.
Lieutenants of special attainments	8	,, Gunnery officers ...	10·9 ,,
	6	,, Torpedo ,, ...	10·8 ,,
	9	,, Navigating ,, ...	11·9 ,,

From the above it is evident that no advantage accrued to those who had the ability to attain the scientific knowledge required for their respective branches, whilst the future of those who selected navigation was marred by having to wait a year longer than any other officer.

Lastly, it may be remarked that it argues well for a service in which science is courted by so many in spite of the small encouragement given in this matter of promotion.

N. G. T.

Organisms and Meteorites.

I SHOULD be glad to know whether anyone has ever attempted to test the hypothesis of Helmholtz and Lord Kelvin that meteorites are possibly the carriers of organised matter. By pulverising a portion taken from the interior of a meteorite it would, I should suppose, be easy to dissolve out and detect any organic matter that was there. The result in any particular case would probably be negative; still, wilder experiments have been tried before now. JAMES WARD.

Trinity College, Cambridge, February 15.

The Gordiidæ in Folk-lore.

THE sudden appearance of the Gordiidæ or hair worms in puddles of water or similar situations has caused the primitive peoples of many countries to evolve a theory of their seemingly mysterious origin. In parts of Scotland they are believed to be the intermediate stage in the development of a horse-hair into an eel; in Iceland and the Færöes, and also in some of the Malayan islands, they are thought to come down with the rain; in the Malay Peninsula they are said to be the offspring of an unnatural union between an earthworm and a female mantis, and to turn into a fern (Lygodium sp.), the creeping rhizome of which some of them (for example, *Chorodes montoni*, Camer.) closely resemble. (I found that a very large proportion of the true Mantidæ were infested by them in the Malay States.) In the same country, by an application of the principle of the doctrine of signatures, they are used in the manufacture of a hair-wash. I have thought that it might be interesting to trace out the beliefs held about them among different races, but I find references to them extremely scanty in ethnographical or general literature. If any of your correspondents could furnish information of the kind I would be extremely grateful, for I believe that an interesting contribution to the biological philosophy of savages might be made by collecting and analysing the different theories held by primitive peoples regarding a small and easily recognised group of animals like the Gordiidæ. NELSON ANNANDALE.

34 Charlotte Square, Edinburgh.

THE ANTARCTIC EXPEDITIONS.

MORE or less detailed accounts have now been published of all the three expeditions—German, Swedish, and Scottish—which, following the lead of the British party in the *Discovery*, have during the past two years striven to extend the bounds of knowledge in the far southern regions. Some idea can therefore be gained of the scientific results obtained in various directions. It is a remarkable illustration of the independence of climatic conditions on mere latitude that, while each of the expeditions wintered outside the Antarctic circle, the rigours experienced have hardly been exceeded in the case of expeditions which have wintered more than 10° nearer the pole in both hemispheres.

To begin with the work of the Swedish party under Dr. Nordenskjöld, of which summaries have been given both in the *Times* and in the *Geographical Journal*, it is mainly of the contributions to meteorology and geology that it is yet possible to speak, though when the magnetic observations have been worked out, results of no less importance may be expected. The value both of the meteorological and magnetic work has been greatly enhanced by the enforced detention during two winters, a much more effective basis of comparison with the observations of other expeditions and stations being thus supplied. Some useful work from a purely geographical point of view has also been accomplished, our knowledge of the contours of the land masses to the south of South America having received welcome additions, mainly as the result of two separate sledge expeditions undertaken during the two winters. The winter station, it will be remembered, was established on the eastern side of Louis Philippe Land, the northern extremity of the mass known further south as Graham Land. It was itself on an island lying to the east of the main mass, but although this appears to be fringed on this side by a regular archipelago of islands separated by wide channels, it was demonstrated—and this is one of the chief geographical results of the expedition—that the larger mass runs continuously southward from Louis Philippe Land to King Oscar Land. It is formed by a high range of mountain peaks separated by large glaciers, and further inland passing into a level ice-covered plateau. Within the outer limit of the archipelago an ice-sheet extended, bounded by a formidable ice barrier running from east to west in the neighbourhood of Christensen Island (an extinct volcano). The conditions of this ice-sheet recalled those of Ross's great ice-barrier on the opposite side of the Antarctic, and, as was found by Captain Scott and his companions on their great southern sledge journey, it was separated from the land by wide, deep, and impassable crevasses. This was ascertained during the first winter expedition, which lasted from September 30 to November 7, 1902, and had its furthest point in 66° S., 62° W. During the second winter the leader, with one companion only, explored the channels leading north behind the islands towards Erebus Gulf. The scenery here was found to be of the grandest kind; on one side was the magnificent range of King Oscar Land, on the other a large archipelago forming a remarkable contrast to the former, and made up of tufaceous volcanic rocks, with sounds, glaciers, and promontories, all dominated by the shining blue-white prominent peak of Mount Haddington, probably formed by a mighty crater. It was during this expedition that Dr. Nordenskjöld luckily fell in with Dr. Andersson and Lieut. Duse, who had left the *Antarctic* before the disaster which befel it, and had spent the winter in that inhospitable region with only a summer outfit.

Throughout the time spent in the far south, the

climatic conditions were generally adverse, the violent gales and great cold experienced during the first winter equalling, if not surpassing, those which so hampered the work of the Newnes Expedition to Victoria Land. During a whole fortnight in May and June the velocity of the wind averaged 45 miles per hour, and, worse than all, it was these south-westerly gales which brought with them the lowest temperatures. Thus the stormiest day (mean velocity 63 miles) was also one of the coldest (mean −24° F.). The mean temperature for the year was about 10·2° F., the same as in Hudson Strait or at Yakutsk, the two coldest places in the north, while the summer showed the exceptionally low mean of 28·2° F., the coldest so far known. In the summer, however, the gales became very much more moderate, being insufficient, in fact, during the first year, to break up the ice—the reason for the failure of the *Antarctic* to reach the winter station; and whereas in winter the snow was all blown away by the gales, in summer a great accumulation of snow was observed on the ice at sea-level. During the whole two years not a single aurora was observed. From a geological point of view the most interesting discovery was that of numerous fossil bones of vertebrate animals, some of great size, while abundant remains of plants were also found, proving that, as in the far north, the climate was once mild, and that there existed large forests of leaf-bearing trees where birds sang and strange large animals fed on the herbage. The fossils in the islands round the station were all of Mesozoic or Tertiary age, but Dr. Andersson had discovered, in the neighbourhood of his winter quarters, a rich fossil flora of a very different type, belonging to an older geological epoch.

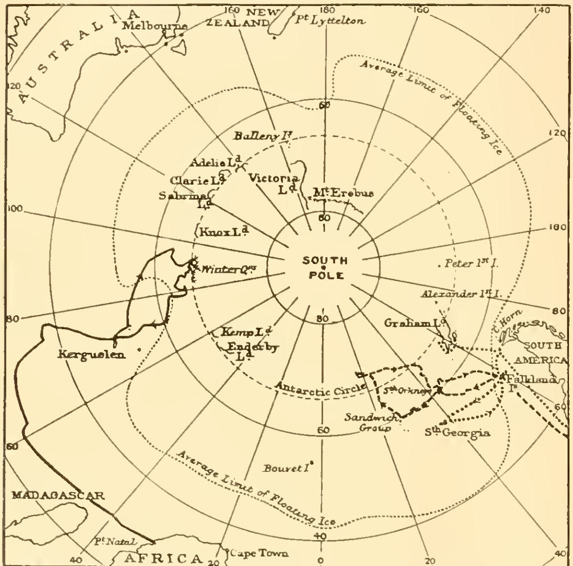


FIG. 1.—Routes of Scottish, German and Swedish Antarctic Expeditions.

Mr. Bruce likewise had much to contend against in the climatic conditions, which seem to have been exceptionally unfavourable during 1903. The results of the work of his party consist mainly—in addition to the full records of magnetic and meteorological observations kept up throughout the winter—of a series of soundings and other scientific observations carried out during a cruise of more than 5000 miles in seas never before visited by a scientific expedition, and of observations on the zoology and botany of the South Orkneys. The result of the soundings was to confirm the conclusion derived from Ross's single sounding further east, showing that between 60° and 71° there is a deep sea with a more or less uniform depth of 2500 fathoms. During this cruise the heaviness of the pack—the ice being real Polar ice, sometimes 15 to 20 feet thick—proved a serious obstacle, and it was only by working eastward along the outer edge of the pack, sometimes north, sometimes south of 60°, that it was at last possible to make a clear run to the south, which took the ship to 70° 21′ S., 17° W., where a sounding of 2543 fathoms was obtained. This was towards the end of February, after which winter quarters were sought in the South Orkneys, the position chosen being a bay on the south coast of Laurie Island. Here the ship remained frozen in for eight months, a fact, Mr. Bruce says, "perhaps one of the most remarkable in the history of Polar exploration—that in an oceanic island in so low a latitude as 60°–61° it was possible to be ice-bound for so long a period." It was probably due to the continuous ice-sheet which formed between the islands and Graham's Land, which had the same effect, temporarily, as the vicinity of a continent. Eventually the ice broke up and cleared out in a single day (November 23). At the winter station a solidly built stone dwelling house was erected and a special magnetic observatory (named after Prof. Copeland), the observations at which, as also the meteorological work, were carried on by Mr. Mossman. Survey work, soundings and tidal observations were also carried on by Mr. Bruce, Mr. Wilton, and the ship's crew. During the spring, foggy and cloudy weather was very prevalent, causing many hindrances, while the rapid variations in temperature—sometimes as much as 40°–60° F. in a single day—were also very trying. All the land is described as very precipitous, rising sheer out of the water, but in spite of this the penguins manage somehow to ascend. Among the zoological facts collected, it was ascertained that the shag which inhabits Antarctic islands is the blue-eyed shag. It is hoped the work of the expedition may be continued for another year.

As regards the German expedition, Dr. Drygalski's preliminary report issued last summer has been supplemented by the publication of the first instalment of the scientific results, while a general account of the expedition has also been given before the Berlin Geographical Society and printed in the *Zeitschrift* of that body (1904, No. 1). It is again in the field of meteorology that some of the most important work has been achieved. The climatic conditions at the winter station of the *Gauss* showed clearly that the zone of the west winds had been left behind and a new climatic

area approached, marked by east winds blowing from a continental region of high pressure in the south. The storms so characteristic of the south polar region were here experienced in their full force. Although the only land actually inspected was the solitary peak of the "Gaussberg," the whole character of the neighbourhood, with its vast sheet of "inland-ice," was such as to argue the existence of a continental mass stretching southward from the Antarctic circle. The ancient crystalline character of the rocks and the sudden fall towards a deep sea in the north point in the same direction. Valuable observations of the ice-conditions, both of the sea and land areas, were made, and the paper in the *Zeitschrift* is accompanied by excellent photographic representations, one showing the stratified formation of an iceberg being especially noteworthy.

THE "FISH HYPOTHESIS" AND THE TRANSMISSION OF LEPROSY.

LEPROSY is a disease that has been known from the earliest times, and in the British Isles was very prevalent in the twelfth and thirteenth centuries. At the present time, though unknown in many countries, it is impossible to traverse any large tract in any continent without meeting with cases, Norway, the Mediterranean littoral, India, China, certain of the Pacific islands and various parts of America and Africa being preeminently the seats of the disease. A bacillus having a strong resemblance to the tubercle bacillus is present in enormous numbers in the leprous tissues, and is regarded as the specific virus, though it is non-inoculable into animals, and, with doubtful exceptions, has never been cultivated.

The transmission of the disease is generally regarded as being due to personal contagion, and there are many facts in support of this view. Segregation of the lepers is believed to be eradicating the disease in Norway; the introduction of a case of leprosy into a place previously free has been followed by a great spread of the disease, as in the Loyalty Islands, and many instances are on record of persons contracting the disease after associating in some way with the sick, whose secretions swarm with the bacilli.

For some months past, Mr. Jonathan Hutchinson, F.R.S., has been strenuously maintaining his "fish hypothesis" of the origin and transmission of leprosy with an ardour and with a wealth of facts and figures that must strike all with admiration. Moreover, Mr. Hutchinson has recently undertaken two journeys, to India and to the Cape, in order to collect data in support of his hypothesis, no light undertakings for a man of his years! Briefly stated in his own words, "the fish hypothesis assumes that in all ages and in all countries, leprosy has been and still is due in the main to the consumption as food of decomposing or imperfectly cured fish. It is thought probable that the disease is a modification of tuberculosis, and that it receives modification in connection with some specific virus (toxin or bacillus) which is occasionally, but by no means frequently, developed in connection with such fish. It assumes that, if the virus be present, a very small quantity of fish may suffice to produce the disease in its full vigour, whilst, if it be absent, large quantities may be habitually consumed without any result. It is a specific poisoning which occurs, and by no means merely a form of ill-health due to unwholesome diet. It has no degrees of less or more, and is either contracted in its totality or wholly escaped. Thus, all who eat fish in bad condition are supposed to run some risk; and those who eat it habitually and largely encounter that risk more frequently than others. It is, however, the quality and not the quantity with which chiefly we are concerned—the presence or absence of the specific virus. For the present the existence of such a virus is a matter of hypothesis, for it has never been isolated from any specimen of fish. Thus the evidence is circumstantial, not demonstrative."

Mr. Hutchinson has directed attention to the incidence of leprosy among Roman Catholic communities; this he attributes to the use of fish during the fasts ordained by that Church. Believing, as he does, that personal contagion plays little or no part in the spread of the disease, he advocates the abolition of leper asylums or at least a great mitigation in the severity of the laws as regards segregation, especially in Cape Colony.

Mr. Hutchinson's hypothesis is doubtless supported by many facts, and there is a remarkable coincidence between fish-eating and leprous districts. Thus in India generally the incidence of leprosy is about three or four cases per 10,000 of the population, but in the island of Minicoy, devoted to fishing, it rises to 150, and in Kaligoan, a fish-curing centre, to 500. The decline of leprosy in the British Isles he would attribute to the improvement in the food of the people and to the introduction of the reformed faith, whereby fasting was abolished. There are, however, grave difficulties in the way of accepting the fish hypothesis as proved. It is almost certain that leprosy is met with among peoples who rarely or never touch fish, *e.g.* the Basutos, as pointed out by Dr. Turner. Mr. Hutchinson has controverted this statement, alleging that Dr. Turner's witnesses were not to be believed, but surely the same argument may be applied to much of Mr. Hutchinson's own evidence. Mr. Hutchinson states that on several occasions he has by cross-examination obtained an admission of fish-eating that had previously been denied. But the cross-examination of an ignorant and perhaps terror-stricken native by a casual visitor is hardly calculated to elicit the truth, and must be carried out with the greatest circumspection or the examinee will infallibly admit that which he believes is required of him. On this ground much of Mr. Hutchinson's evidence must be regarded as untrustworthy. Then there is the difficulty as to why fish in bad condition conveys the disease, whereas good fish, fresh or dried, is innocuous. Why is the virus present in bad fish and not in fresh fish, where does it come from, and how does it get there? These are questions that require an answer, for it is admitted that the leprosy bacillus has never been met with apart from the leprous person; there is absolutely no proof, or even suspicion, that fish harbour the leprosy bacillus. Orkney and Shetland formerly suffered greatly from leprosy, but Mr. Traill Skae, in a letter to the *British Medical Journal*, entirely denies that the food of the people has much improved and asserts that enormous quantities of bad fish are still consumed. It would seem much more likely that the civilisation of a people that will eat bad fish is low and that promiscuous intercourse of all kinds is, therefore, habitual, leading more readily to personal contagion; this would explain the connection, if there be one, between the consumption of bad fish and leprosy.

As regards segregation being useless, Dr. Ehlers states that in Iceland, during the five years after the opening of the asylum in 1899, the number of lepers, which had previously been increasing, diminished by one-fourth. The statement that segregation is useless is against all experience, though there is, doubtless, much to be said for a modified form of segregation and for a revision of the leprosy enactments in Cape Colony.

With regard to the remarkable waxing and waning of leprosy in many countries, this is seen in nearly every

infective disease. A disease introduced into virgin soil is apt to spread rapidly; where the soil is not virgin there is frequently a periodicity which at present cannot altogether be explained. Thus the ordinary "zymotic" diseases in the British Isles, diphtheria, scarlet fever, &c., have a seasonal and an epidemic periodicity; other diseases, notably influenza and plague, may for years be almost unknown, and then an epidemic prevalence may become established over such large areas that the disease becomes pandemic. The same unknown causes may have much to do with the extinction of leprosy in the British Isles and elsewhere.

R. T. HEWLETT.

NOTES.

THE Russian Imperial Geographical Society has conferred the Lütke gold medal—its highest distinction—on Sir John Murray, K.C.B., F.R.S., for his oceanographical and limnological researches. The medal has only once before been conferred on a foreigner, namely, Prof. Suess, of Vienna, the eminent geologist.

MR. JAMES HORNELL, who acted as Prof. Herdman's assistant during the Ceylon pearl oyster investigation, has been appointed marine biologist to the Government of Ceylon, and inspector of the pearl banks. Mr. Hornell is now preparing for an inspection by means of dredges in place of divers, with the view of carrying out the changes recommended in Prof. Herdman's report. The appointment is of interest as showing how in the recognition of science some of our colonies are in advance of the mother country. We have no "marine biologist to the Government" here.

DR. J. E. MARR, F.R.S., was elected president of the Geological Society at the anniversary meeting held last Friday. Sir Archibald Geikie delivered the anniversary address, his subject being continental elevation and subsidence. The medals and funds at the disposal of the society were presented as already announced (p. 255).

THE death is announced of Prof. Callandreau, professor of astronomy in the Paris École polytechnique, and member of the Paris Academy of Sciences.

AN astronomical society has been formed at Newcastle-upon-Tyne under the presidency of the Rev. T. E. Espin, who will give the first lecture, at the Literary and Philosophical Society's rooms, on Friday, March 11, on "The Work of an Amateur Observatory." The hon. secretary of the society is Mr. J. D. Hastings, Warkworth House, Tynemouth.

A BILL for rendering compulsory the use of the metric system of weights and measures in the United Kingdom was read a second time in the House of Lords on Tuesday and referred to a select committee. The Bill provides that the metric system shall become compulsory on April 5, 1906, or at such later date as may be directed by His Majesty by Order in Council. It is, therefore, left to the discretion of the Government to fix the date for inaugurating the compulsory adoption of the system. In moving the second reading of the Bill, Lord Belhaven referred to the recommendations of the Select Committee of the House of Commons in 1895, and pointed out the educational and commercial advantages which would follow the adoption of the metric system in the place of our present irrational standards. Lord Kelvin, speaking in support of the Bill, remarked that in Germany, France, and Italy, no inconvenience had resulted from the introduction of the metric system. He said it was of interest to know that the decimal system originated in England. In a letter dated November 14, 1783, James Watt laid down a plan which was in all respects the system adopted by the French philosophers seven years later, which they suggested to the King of England as a system that might be adopted by international agreement. James Watt's objects were to secure uniformity and to establish a mode of division which should be convenient as long as decimal arithmetic lasted. Speeches in favour of the Bill were made by Lord Wolverton, the Marquis of Lansdowne, and the Earl of Rosebery.

THE Reale Accademia dei Georgofili, of Florence, offers a prize, a diploma, and a silver medal for the best essay on the fiscal policy in Italy in relation to that of other countries from the introduction of the 1887 tariff to the end of 1903. The competition closes on June 30, 1905. The Olympic Academy of Venice offers a prize, the subject being Italian emigration in South America, and the last day being December 31, 1906.

THE *Revue générale des Sciences* contains an account, by M. A. de Lapparent, of the life and work of M. Munier Chalmas, who died at Aix les Bains on August 8, 1903, scarcely three months after his election into the Académie des Sciences. M. Munier Chalmas was born in the Beaujolais district in 1843, and at the age of fourteen his interest in geology was aroused by his meeting a geological party of students near Paris, conducted by M. Hébert. At nineteen he had studied under Cordier and D'Orbigny. On the death of M. Hébert in 1890 a movement was set on foot to appoint him to the chair thus vacated at the Sorbonne. M Munier Chalmas's contributions to palæontology were numerous and varied, and dealt with the calcareous algal remains previously regarded as Foraminifera, the dimorphism of Nummulites and Miliolidæ, the classification of echinids, the morphology of brachiopods, and the embryonic development of ammonites. The present state of our knowledge of the geology of the Paris basin is largely due to his researches. He rendered valuable services in the preparation of the geological map of France, and his investigations extended also to Dalmatia and Hungary.

THE death is announced of Prof. Arthur W. Palmer, head of the department of chemistry of the University of Illinois. Prof. Palmer, says *Science*, graduated from the University of Illinois in 1883, and was for two years assistant in the department of chemistry. In 1890, after studying for two years at Harvard University and one year in Germany, he was appointed professor of chemistry, and has since served continuously in that capacity. As member of the Chemical and Biological Survey, he had lately completed an important report on the water supply of the State of Illinois, and was the author of many papers embodying the results of chemical investigation.

AT the annual general meeting of the Institution of Mechanical Engineers on February 19, the annual report of the council for the year 1903 was presented, and contains the following announcements among others. The sixth report of the Alloys Research Committee has been completed. It deals with the experiments made, under the late Sir William Roberts-Austen's direction, on the tempering and annealing of steel, by Mr. William H. Merrett and by others. At the request of the committee the report was completed by Prof. Gowland. The first report to the Steam-Engine Research Committee, by Prof. D. S. Capper, has been received, and will shortly be presented. Prof. Burstall reports that the 100 B.H.P. gas engine which has been designed for experimental work in connection with

the Gas-Engine Research Committee is now ready to be tested at the works. Prof. T. Hudson Beare, the reporter to the Committee on the Value of the Steam Jacket, carried out during the summer and autumn a number of experiments with the experimental jacketed vessel; the results obtained are now being worked out, and further experiments are in progress. New, and it is hoped more satisfactory, valve arrangements for admitting the steam to and exhausting it from the experimental vessels are now being designed. A cordial invitation from the American Society of Mechanical Engineers to hold a joint meeting in Chicago, with the view of visiting afterwards the St. Louis Exhibition, has been accepted by the council on behalf of the members.

Prof. F. G. Baily, in a short article in the *Electrician*, gives the results of some tests on the efficiency and colour of the new osmium lamps. He finds that the consumption of power at the correct running voltage is about 1·9 watts per candle, and that the colour of the light at this efficiency is practically the same as that of a carbon lamp running at 2·1 watts per candle. From this it seems that the osmium filament is slightly superior to a carbon filament as a radiator, though the main cause of the higher efficiency of the lamp is the higher temperature which the osmium filament can stand. The only trustworthy life tests yet published are those made by Prof. Wedding, who found an average life of 1900 hours from a test on eighteen lamps starting at an efficiency of 1·7 watts per candle; at the end of the life the candle-power had fallen off about 20 per cent., and the efficiency was 2·1 watts per candle. According to Prof. Baily's tests, the osmium lamp is not quite so sensitive to voltage variations as a carbon lamp; at the same time the difficulty of producing a high voltage lamp does not seem to have been overcome, the highest P.D. for which lamps are manufactured being 55 volts. This cannot fail to act as a great drawback to the introduction of the lamp into commercial use.

Mr. H. C. Russell, Government Astronomer of New South Wales, has sent us a copy of the results of rain, river and evaporation observations made in that colony during the year 1900; the tables are illustrated by maps and diagrams. Mr. Russell states that the year's rainfall is a little better than that of the five preceding years, but it was nevertheless much below the average fall. Our knowledge of the distribution of rain over New South Wales is almost entirely due to Mr. Russell's persistent exertions; when he first undertook the systematic collection of rainfall statistics in the colony, in the year 1870, he found only five rain gauges in use; at the present time (1900) the number of recording stations has increased to 1703. Mr. Russell's study of the periods of floods and droughts has led him to the conclusion that these periods have followed each other with regularity, and he predicts that in 1904 and 1905 the rainfall will be abundant. In support of this he states that he has discovered, to his own satisfaction, that the rainfall is controlled by the moon, and he gives a diagram showing that when the moon's course is to the southward, in the southern hemisphere, more rain falls than when the moon moves to the northwards.

Symons's Meteorological Magazine for this month contains the very interesting summary of the climate of the British Empire during the year 1902, in the same form that it has appeared for many years. Several new stations have been added, but, as pointed out by Dr. Mill, it is still far from being fully representative of all the varying climates of the Empire. Two of the new stations take a place among the "records" for the year:—(1) Madras shows the highest mean annual temperature yet quoted in these tables (83°·2), the lowest being Winnipeg (37°·6); (2) Coolgardie (W. Australia) has the greatest mean daily range (25°·5), the least being Hong Kong (8°·6). Coolgardie owes its great range to high maxima, whereas Winnipeg, which held the place for sixteen years, owed it to low minima. The highest shade temperature was 111°·4 at Adelaide in February, and the lowest −36°·1 at Winnipeg in January. The driest station was Adelaide, mean humidity 59, and the dampest was Trinidad, 82. The latter station had the highest temperature in the sun, 177°·0. The greatest rainfall was at Colombo, 117 inches, and the least at Coolgardie, 14·7 inches. The greatest amount of cloud was at London (6·6), and the least at Grenada (2·9). The returns from Dawson were incomplete; the absolute minimum temperatures for November to January varied from −48° to −51°.

Messrs. Lucien Allègre and Co. have opened an exhibition at 99 Regent Street of work done upon the "Luna" printing-out paper, for which they are the agents. This paper has been considerably used on the Continent for three or four years, and is now being introduced into this country. It differs from other silver papers in that the sensitive salts are not carried in a film or layer of medium, but permeate the substance of the paper itself. It is prepared by soaking the paper, or other material, in an aqueous liquid that contains the sensitive salts. The picture may therefore be printed on either side of the paper so far as its sensitiveness is concerned. The platinum toning bath recommended gives a wide range of colours from reds, through browns and violets to black, according to the time that it is allowed to act. A partially exposed print may be developed by an acid developer, and in this way more contrast is obtained. Similar paper is made for the production of transparencies for decorative purposes or for the reproduction of negatives. The advantages of retaining the actual surface of the paper instead of coating it with a film are obvious to those interested in the matter, especially as the brilliancy of the resulting image does not appear to suffer. The exhibition will remain open for a few months.

No. 4 of the first volume of the Indiana University *Bulletin* contains valuable lists of certain sections of the local fauna and flora.

Twenty years having elapsed since the publication of Mr. G. T. Porritt's well-known "List of Yorkshire Lepidoptera," the author has been well advised in issuing a new and enlarged edition, containing not only additions to the number of species, but likewise recording fuller information with regard to habitat, and including notes on variation. The new issue forms part xxx. of the *Transactions* of the Yorkshire Naturalists' Union.

In the course of a note on a specimen of a killer-whale recently stranded on the coast of Maine, Mr. F. W. True (*Proc.* U.S. Nat. Mus., xxvii. p. 297) comes to the conclusion that there are probably several distinct forms of these cetaceans, but that there is not yet sufficient material for properly defining them. The typical species, commonly known as *Orca gladiator*, apparently ranges right across the Atlantic.

We have received a copy of the sixth instalment (from the *Biological Bulletin*) of an essay on the eyes of the blind vertebrates of North America, the author, Mr. E. F. Muhse, discussing in this instance those of a Cuban blind snake (*Typhlops lumbricalis*). Hitherto the structure of the eye

in this genus has been known only in two Old World species, and the author institutes comparisons between this organ in the two latter and in the American form.

To the *Bulletin* of the American Museum Dr. J. E. Duerden communicates an article on certain small sea-anemones infesting West Indian sponges. In the dead state they are white, and look not unlike small serpulæ. Although many species and at least two genera have been founded for their reception, they all appear referable to three species of the one genus Parazoanthus, and their range extends from the Bermudas and Bahamas to the Lesser Antilles.

Among our weekly budget are two faunistic papers, the one, by Messrs. Snodgrass and Heller, dealing with the birds collected during the Hopkins-Stanford Expedition, and the other, by Messrs. Eigenmann and Kennedy, with a collection of fishes from Paraguay. Several new forms are described in the latter paper, which is from the *Proceedings* of the Philadelphia Academy, but in the former, which is published in the *Proceedings* of the Washington Academy, all the novelties appear to have been previously named in preliminary notices.

Prof. L. Errera, of the Royal Academy of Brussels, has favoured us with a copy of the second edition of his brochure entitled "Une Leçon Élémentaire sur le Darwinisme," which is published at Brussels, and is considerably larger than its predecessor. The main arguments in favour of evolution—and more especially Darwinism—are treated in a popular style, emphasis being laid on the importance of the evidence afforded by the phenomena of hybridism and variation, as well as on that derived from the geographical distribution of organisms.

We have received a copy of the reports of the Ulster Fisheries and Biology Association for 1903 the first working year of that body. It is satisfactory to learn that, under the able management of the hon. director, Prof. G. Wilson, and the hon. secretary, Mr. R. Patterson, the association is starting on its career under the best auspices, and has already done good work. The hon. secretary requests us to state that the laboratory at Larne Harbour, which is provided with a steam-launch and dredging outfit, and has a resident naturalist, is now in working order. The resources of the establishment are at the disposal of any working naturalist, with the proviso that the results of any investigations undertaken should be published through the association. The secretary adds that this is the first opportunity afforded to British naturalists of working with comparative ease and comfort on marine biology in Ireland, and a wide field of labour lies before them.

A very complete list of Irish hepatics, with their geographical distribution, has been published by Mr. D. McArdle in the *Proceedings* of the Royal Irish Academy. The writer has taken up the work which was begun by the late Dr. More, who issued a report of Irish hepatics in 1876. The botanical district of Kerry and south Cork is particularly rich in rare species which have been collected in the Killarney district and in the Dingle Peninsula.

A leaflet has been issued by the Board of Agriculture having reference to the pine beetle, *Hylesinus piniperda*, which infests all varieties of pine trees, but rarely attacks other soft-timber trees. The damage is mainly caused by the destruction of the young shoots, into which the beetles bore in June or July, with the result that in the autumn many of these break off. The most effectual remedy is to destroy the larvæ which are found under the bark in May.

Of the numerous additions to the botanical department of the Natural History Museum which are recorded in Dr. G. Murray's report for 1902, the most important are the late Mr. Comber's collection of diatoms, including microscopical preparations, lantern slides and photographs, which was presented by his widow, and the herbarium of hepatics which was purchased from Mr. W. H. Pearson. Besides this report, there appears in the *Journal of Botany* (February) a list of Leicestershire lichens, compiled by Mr. Horwood, which is supplementary to that contained in the flora of the county.

Mr. Horace Cox has published a fourth edition of Mr. W. B. Tegetmeier's "Pheasants: their Natural History and Practical Management." The new edition has been enlarged.

A second edition of Mr. A. T. Warren's "Experimental and Theoretical Course of Geometry" has been published at the Clarendon Press, Oxford. The propositions required, according to the most recent changes in the syllabus of the universities, for pass examinations at Oxford and Cambridge, have been included in the new edition.

A copy of the "Year-Book of the Royal Society of London" for 1904 has been received. It contains, in addition to other information, a list of the fellows of the society; particulars of the standing, occasional, and sectional committees; the statutes of the society; the standing orders of the council; the regulations for administering the Government grant for scientific investigations; the report of the council; and the president's anniversary address.

The publication of a series of monographs on scientific subjects has been commenced by the firm of Vieweg and Son, Brunswick. The first volume, which has just appeared, is a translation into German of Mme. Curie's thesis on radio-active substances, by Herr W. Kaufmann. A list of papers on radio-activity, brought up to October, 1903, is given at the end of the volume.

The Smithsonian Institution has just published an index to the literature of thorium from 1817 to 1902. The compilation has been carried out by Dr. C. H. Joüet, of Columbia University, and 1123 scientific papers dealing with the chemistry of thorium are indexed in the publication.

In the January number of the *Proceedings* of the American Academy of Arts and Sciences, Mr. W. E. McElfresh describes experiments on the influence of occluded hydrogen on the electrical resistance of palladium. The resistance increases with the quantity of hydrogen occluded, but the two factors are not strictly proportional. By the occlusion of 1030 volumes of hydrogen, which represents the maximum absorption, the electrical resistance is increased by about 68 per cent.

The reaction between potassium iodide and hydrogen peroxide in neutral aqueous solution has been the subject of frequent investigation. According to experiments of Walton, published in the current number of the *Zeitschrift fur physikalische Chemie*, it appears to be established that the decomposition of the hydrogen peroxide with the evolution of oxygen is due to a catalytic action of the iodine ions. The production of small quantities of iodine and alkali makes it probable that hypoiodite is formed as an intermediate product, the chief reaction taking place according to the equations

$$KI + H_2O_2 = KIO + H_2O$$
$$KIO + H_2O_2 = KI + H_2O + O_2$$

The second reaction takes place with very great velocity in comparison with the first.

THE *Comptes rendus* for January 25 contains an account of the experiments recently made by Profs. Dewar and Curie on the gas "occluded or liberated" by radium bromide. Three series of experiments are described. In the first series a glass tube containing 0·4 g. of the salt was exhausted by means of the mercury pump, and was found to liberate gas to the extent of about 1 c.c. per month; this gas, examined spectroscopically, gave only the hydrogen and mercury spectra. The salt was then taken to the Royal Institution, transferred to a quartz tube, connected to the mercury pump, and heated to the melting point of the salt; the gas liberated was passed through three U-tubes cooled with liquid air to condense the emanation and the less volatile gases, and collected over mercury. The gas, which had a volume of 2·6 c.c. at atmospheric pressure, was intensely luminous, and three days' exposure in a quartz spectroscope showed the presence of the three chief bands of the nitrogen spectrum. During this time the glass tube had become violet in colour, and the volume of the gas had been spontaneously reduced to one-half of its original volume. A small sample of the gas was transferred to a Geissler tube, and again exhibited the nitrogen bands. Finally, the nitrogen in the Geissler tube was frozen out by means of liquid hydrogen, when a very high vacuum was produced, but the spark spectrum again indicated the presence of nitrogen and no other gas. The quartz tube containing the fused radium bromide was sealed off whilst still vacuous by means of the oxyhydrogen blowpipe and taken back to Paris. It was there examined, twenty days later, by M. Deslandres, who covered the ends of the tube with tinfoil and illuminated the gas by means of a Ruhmkorff coil; three hours' exposure in a quartz spectroscope revealed a complete helium spectrum, but the light emitted spontaneously by the tube gave a continuous spectrum free from light or dark bands.

THE additions to the Zoological Society's Gardens during the past week include two Ring-necked Pheasants (*Phasianus torquatus*) from China, presented by Mr. Eardley Wilmot Holt; an Undulated Grass Parrakeet (*Melopsittacus undulatus*) from Australia, presented by Mrs. Clement Shorter; a Bullfinch (*Pyrrhula europoea*), European, presented by Mr. R. F. Hearnshaw; an Indian Python (*Python molurus*) from India, presented by Mr. W. A. Harding; a Citron-crested Cockatoo (*Cacatua citrino-cristata*) from Timor Laut, deposited; an Arctic Fox (*Canis lagopus*) from the Arctic regions, purchased.

OUR ASTRONOMICAL COLUMN.

OBSERVED CHANGES ON THE SURFACE OF MARS.—During his observations of the Martian surface on April 19, 1903, Mr. Lowell, of Flagstaff, was surprised to see that the colour of the Mare Erythræum was a decided "chocolate-brown," whilst the neighbouring Syrtis was of the normal "blue-green." Although the sea was similarly situated for observation on March 22, this peculiarity was not seen then, therefore the change must have taken place somewhere between these two dates.

When this region was again favourably placed for observation, viz. on May 26, the Mare Erythræum had lost the brown colour except in the southern regions, and the remaining colour slowly disappeared southwards, until on May 29 only a small region near to Hellas was affected, and this became normal on May 30. During the next presentation (June 30–July 7) there was no suspicion of any chocolate coloration. Taking the time of maximum brightness of the brown colour as the time of minimum for the "blue-green" which it supplants, Mr. Lowell finds that this minimum coincides, in point of time, with the minimum visibility of the canals, and, further, that the minima also coincide in latitude, travelling southwards in each case as the number of days since the summer solstice increases. This is plainly shown by the curves and tables in which Mr. Lowell displays the results of his observations of the respective phenomena.

From these data he argues that the normal blue-green colour is due to vegetation, which, owing to the absence of large bodies of water on the planet's surface, can only thrive when fed by the water which fills the canals at the melting of the polar snows. He also suggests that the brown colour, which accompanied the minimum visibility of the canals, is due to the exposure of the bare soil which probably covers the beds of such "seas" as the Mare Erythræum (Lowell Observatory *Bulletin*, No. 7).

THE GEOGRAPHICAL DISTRIBUTION OF METEORITES.—In an article contributed to the February number of the *Popular Science Monthly*, Dr. O. C. Farrington, of the Field Columbian Museum (U.S.A.), discusses the distribution of the meteorites which have been discovered on the earth's surface. He points out that, according to Prof. Berworth, of Vienna, about 900 meteorites reach the earth annually, but from various causes the number likely to be observed is only about 55 per annum, or 5500 per century. As a matter of fact, there have only been about 350 recorded falls since the fifteenth century, yet there have been 50 well authenticated falls in France during the last 100 years.

Dr. Farrington explains the apparent discrepancy by pointing out that on a map of the world, on which he has marked the places where meteorites have been found, these places are mostly in civilised and thickly populated countries, and it may therefore be surmised that the residue are either not seen or else not recorded. Another very interesting point illustrated by the map is the comparatively large proportion of meteorites which have fallen in mountainous regions (*e.g.* the Himalayas, the Alps, the Appalachian Mountains, &c.), and to explain this Dr. Farrington suggests either increased gravitational effects near to these mountainous ranges or else the actual mechanical arrestation of the meteorites by the projecting mountains.

An analysis of the types of known meteorites discloses curious "grouping"; for instance, including both "falls" and "finds," it is seen that of the 256 meteorites known in the western hemisphere, 182 are "irons" and only 74 are "stones," whilst of the 378 known in the eastern hemisphere, 299 are "stones" and 79 are "irons." Prof. Berworth has suggested that the dry air of the large desert areas of the New World has caused the preservation of the irons, whilst the moist atmosphere of the Old World has caused their disintegration, but Dr. Farrington points out that quite a fair proportion of the "irons" found in America have come from the region surrounding the Appalachians, where a comparatively moist atmosphere obtains. Several other apparent localisations of particular types are discussed by Dr. Farrington in his interesting article.

AN ATLAS OF SOLAR PHOTOGRAPHS.—At the meeting of the Paris Académie des Sciences held on February 1, Prof. Janssen presented an atlas of photographs of the sun's disc which have been taken regularly at the Meudon Observatory since 1876. These photographs have been chosen, from more than 6000 plates obtained between 1876 and 1903, in order to show the finest examples of the various solar phenomena, and they display a fairly complete history of the solar changes during that period.

The photographs were taken with an especially constructed camera which produces a nearly monochromatic image, using the exceedingly actinic light in the violet region about $\lambda\lambda$. An exposure of 1/3000 of a second was generally found sufficient, and therefore the resulting pictures show all the finer details of the solar surface beautifully defined.

In presenting the atlas Prof. Janssen directed attention to the great importance of obtaining such a record at several widely separated observatories, because, in the light of their inter-relation with meteorological and magnetic phenomena, it is obviously desirable to have a *complete* record of the changes which occur on the sun's surface, and such a record cannot be secured if only one or two observatories are taking photographs. Recognising the importance of this record to meteorologists and physicists, it is intended to prepare a large edition of the atlas, on a smaller scale, for wide distribution (*Comptes rendus*, No. 5).

CONCERNING GIRAFFES.

THE recent acquisition by the British Museum of specimens from East Central Africa and elsewhere has brought into prominence the question of how best to designate the various forms of giraffe to be met with in different regions of Ethiopian Africa, that is to say, whether they should be regarded as distinct species, local races of a single species, or mere, so to say, accidental variations not worthy of systematic separation. The question has been discussed at length in a paper by the present writer read before the Zoological Society on February 2, when a number of paintings and photographs of entire specimens, skins, and skulls were exhibited.

Without entering into details, it may be mentioned, as a matter of common knowledge, that the giraffes of northern Africa—including the typical *Giraffa camelopardalis* of Linnæus—are characterised by the presence in the male of three horns, supplemented in some cases by a rudimentary pair on the occiput, and their white legs. Giraffes of this general type extend at least as far south as the neighbourhood of Lake Baringo and Mount Elgon, that is to say, considerably to the southward of the equator. The accompanying illustration (Fig. 2) exhibits the aforesaid cranial features in the giraffe of the Baringo district.

On the other hand, when the southern districts of the continent are reached, we find that the frontal horn of the adult bull giraffes has been reduced to a more or less inconspicuous irregular boss, while the legs have become spotted right down to the hoofs. Giraffes displaying these two characteristics occur as far north as the northern Transvaal, although, so far as can be judged from a single specimen, the form from that region (Fig. 1) differs decidedly in its markings and colour from the well-known giraffe of the Cape district, as it also does in certain features of the skull.

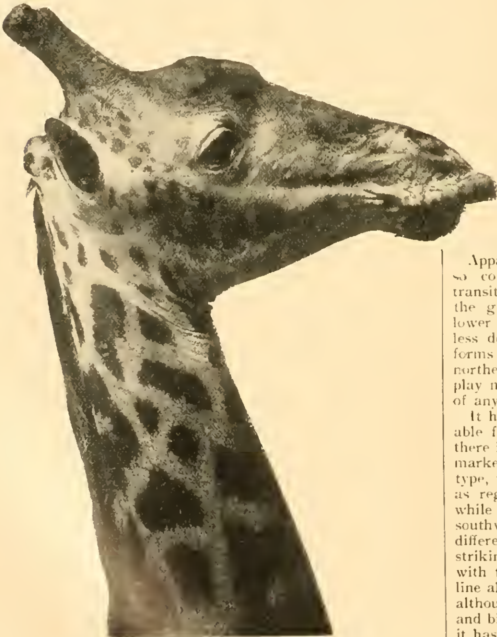


FIG. 1.—Head and neck of North Transvaal bull Giraffe, presented to the British Museum by Mr. Rowland Ward, to show Southern type.

FIG. 2.—Head and neck of old bull of Baringo Giraffe, presented to the British Museum by Sir H. H. Johnston, to show Northern type. (From "Guide to Mammalia in British Museum.")

Apparently, although our information is far from being so complete as is desirable, the nearest approach to a transition between these two extreme types is displayed by the giraffes of the Kilimanjaro district, which have the lower portion of the legs partially spotted, and tend to show less development of the third horn. Not that the known forms in any way form a complete transition between the northern and southern types. On the contrary, they display markings peculiarly their own, and quite unlike those of any of the others.

It has been already stated that there are two distinguishable forms of giraffe belonging to the southern type (and there is a third in Angola). It should be added that equally marked local differences occur in the case of the northern type, the aforesaid Baringo giraffe being strikingly different as regards markings and colour from the Nubian animal, while a giraffe brought by Major Powell-Cotton from the southward of Lado (just north of the equator) appears different from both. Then, again, there is the very strikingly coloured Somali giraffe, which, while agreeing with the northern type in cranial characters, strikes out a line altogether its own in the matter of marking and colour, although in both these respects it merely displays an ultra and bizarre development of the northern type. Nevertheless, it has been regarded as indicating a species apart from the one including all the other forms.

To discuss further the characteristic features of the foregoing and other forms of giraffe until the paper in question has been published would obviously be inadvisable. Sufficient has, however, been stated to afford a general idea of the question at issue, namely, are these various local forms of giraffe constant, and, if so, should they be regarded as species or races?

Apart from the Somali giraffe, which certainly differs in colour and marking more from all the others than do the latter *inter se*, the aforesaid tendency to a gradation (with many local side-developments) from the northern three-horned and white-stockinged to the southern two-horned and spot-legged type points to the advisability of regarding the local colour-forms as races rather than species (in the modern sense of both terms). It should be mentioned, however, that at present, at all events, there is no sign of one local form grading into another, although subsequent discoveries may prove this to exist.

Then comes the question, are these local forms constant and invariable (save for individual tendencies towards albinism or melanism)? Dealing solely with available facts, and not admitting hypothesis, the answer to this, so far as our present information goes, is in the affirmative. Of course, additional specimens of each form are desirable, but all the examples of each type at present available point to the conclusion that such types are constant locally, and it is therefore obvious that it is incumbent on those who dispute this assertion to substantiate their objections by producing specimens showing individual variation in one and the same locality.

As regards the evidence for constancy of local type, it may be mentioned that the herd of Nubian giraffes formerly in the Zoological Society's Gardens, together with the numerous specimens that have of late years been imported into Europe, are amply sufficient to demonstrate the absence of individual variation in this case. The proof of constancy of type is nearly equally strong in the case of the Cape giraffe, despite the fact that as we proceed north a change in the nature of the markings is noticeable. The Baringo and Kilimanjaro giraffes, allowing for marked differences according to age and sex, are also known by a considerable number of specimens, so that there is every probability that their respective types of coloration are fairly constant, and the evidence for such constancy is still more satisfactory in the case of the Somali giraffe. As regards the other named forms, it must be admitted that their right to separation rests on the evidence of single specimens. Still, if constancy of type occurs in the other forms, the presumption is that it also obtains in these.

If, of course, Kilimanjaro giraffes were met with among a Baringo herd, or *vice versâ*, the case for the racial distinctness of the local forms would be at once demolished, but no evidence of such an admixture of type has ever been recorded. Until this is observed, we are accordingly entitled—or rather compelled—to regard the differences in the colour and markings of giraffes from different localities as indicating local races precisely analogous to those of the bonte-quagga, or Burchell's zebra. The extent of area covered by these local forms, whether some of them may be anything more than individual variation, and whether on the borders of their respective ranges they interbreed with the neighbouring races, or, as is more probable, keep perfectly distinct, are factors in the question still awaiting definite answers.

In conclusion, reference may be made to the extremely important and valuable additions to our knowledge of these animals which have resulted from the specimens collected by Major Powell-Cotton during his recent expedition to East Central Africa. The only pity is that, by reason of the game-preservation laws, he was prevented from bringing away such a series of examples of the different local forms as would have sufficed to convince even the most sceptical of their respective constancy to a common type.

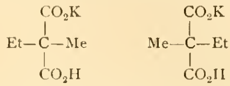
R. L.

A DIRECTED SYNTHESIS OF AN ASYMMETRIC COMPOUND.

All previous attempts to synthesise an optically active carbon compound have been based on one principle; they have involved the combination of an inactive compound, containing an ethylene linkage or a carbonyl group, with an optically active substance to form an ester or glucoside, and the subsequent treatment of this product in such a way as to attach two different groups to a previously ethenoid carbon atom so as to render it asymmetrical. As Prof. Japp and others have pointed out, the two possible isomerides should not necessarily be formed in equal quantities, so that on hydrolysing the new ester or glucoside one of the isomerides would preponderate, and therefore an optically active product should be obtained. Prof. Kipping reduced the bornyl ester of benzoyl formic acid to the bornyl ester of mandelic acid, hoping to obtain an optically active mandelic acid. Prof. Fischer and M. D. Slimmer added hydrogen cyanide to helicin; they then hydrolysed the nitrile and subsequently the glucoside, with the object of preparing active oxymandelic acid.

Prof. Kipping's product proved to be inactive, and it was not conclusively established that that obtained by Fischer was active.

In the last number of the *Berichte*, Prof. Marckwald, of Berlin, describes the synthesis of active *l*-valerianic acid. Methylethylmalonic acid forms two acid salts, which in the case of the potassium salt are enantiomorphously related



and will possess the same solubility, whereas the two acid salts with an optically active base, such as brucine, will in general have different solubilities. Methylethylmalonic acid loses carbon dioxide when heated, forming methylethylacetic acid, which contains an asymmetric carbon atom; it is to be supposed that from the acid brucine salts of the malonic acid the free carboxyl group will be preferentially eliminated. Led by these considerations, Prof. Marckwald crystallised the less soluble brucine salt from the mixture of the two in the expectation of obtaining a material in which presumably the one form of the asymmetric compound would preponderate. This salt was heated at 170°. The valerianic acid obtained was optically active to the extent of $-1°.7$ per 10 c.c., which may be taken as an indication of the presence of 10 per cent. of *l*-valerianic acid.

BAROMETRIC SEESAWS.

Prof. Hofrath Julius Hann has recently contributed an important paper to the Vienna Academy, an abstract of which is printed in the *Akademischen Anzeiger*, No. 1, of the Kaiserliche Akademie der Wissenschaften in Wien. This paper is entitled "Die Anomalien der Witterung auf Island in dem Leitraume 1851 bis 1900 und deren Beziehungen zu den gleichzeitigen Witterungsanomalien in Nordwest Europa." In this Prof. Hann discusses the relationship between the monthly and yearly means of the temperature, pressure and rainfall of Stykkisholm, in Iceland, for the longest time available, the temperature variations at Greenwich, Brussels and Vienna, the pressure and rainfall variations at Brussels and the pressure variations at Vienna.

The results at which he has arrived are of very great interest, for they show that there is a most intimate connection between Icelandic meteorology and that of north-west Europe. For a full account of these the reader must refer to the abstract itself, but some of the results may be briefly summarised here. In the first place, for the three winter months the pressure variations of north-west and middle Europe are for the most part simultaneously of opposite sign to those at Stykkisholm, while the same reversal occurs to a slight extent with the temperature and rainfall. Again, when the pressure variation for a month in Stykkisholm is negative, the probability for a positive temperature variation in north-east and middle Europe is 0·82, and *vice versâ* with a probability of 0·73. Again, contrasting temperature and pressure variations, the following results were obtained:—

	No. of cases	Mean variation: Pressure, Stykkisholm mm.	Mean variation: Temp. Greenwich Brussels °C	Probability of sign of temp. variation
Winter half year ...	67 ...	+8·6 ...	−1·5 ...	0·81
Summer half year...	55 ...	+3·8 ...	−0·5 ...	0·65
Winter half year ...	72 ...	−7·7 ...	+1·4 ...	0·90
Summer half year...	50 ...	−5·0 ...	+0·7 ...	0·76

Prof. Hann shows further that the probabilities of positive temperature variations at Greenwich and negative pressure variations at Stykkisholm, and *vice versâ*, are 0·83 and 0·85 respectively. In the case of the Azores he shows that a similar reversal with Stykkisholm occurs. Interesting results are also obtained when he considers the new station at Angmagsalik, in Greenland.

THE AMERICAN ASSOCIATION.

THE annual meeting of the American Association for the Advancement of Science was held at St. Louis on December 26, 1903, to January 1. The address delivered by the president of the association, Prof. Ira Remsen, appeared in NATURE of January 28; and extracts from the addresses of presidents of some of the sections are given below.

ATOMS AND ELEMENTS.[1]

Is matter continuous or discrete? argued the opposed schools of Grecian philosophy led by Leucippus, Democritus and Epicurus, and dominated by Aristotle. Despite the clarity of the statements of the Roman Lucretius,[2] the atomic hypothesis received scant attention until the seventeenth century of the Christian era, when Galileo's experimental science assailed Aristotelian metaphysics and demanded verification of the premises of that philosophy which had governed all the schools of Europe for two thousand years.[3] While Gassendi, Boyle, Descartes, Newton, perhaps Boscovich, Lavoisier, Swedeborg, Richter, Fischer and Higgins had to do with our modern atomic theory, Dalton one hundred years ago "created a working tool of extraordinary power and usefulness" in the laws of definite and multiple proportions. As Clarke[4] remarked, "Between the atom of Lucretius and the Daltonian atom the kinship is very remote." Although the lineage is direct, the work of Berzelius, Gmelin and others; the laws of Faraday, Gay Lussac, Avogadro, Dulong and Petit; the reformations of Laurent and Gerhardt, but particularly Cannizzaro; the systematisations of de Chancourtois, Newlands, Hinrichs, Mendeléeff and Lothar Meyer; the stereochemistry of van 't Hoff and Le Bel have imperialised the ideas of the Manchester philosopher, so that the conceptions of the conservative atomists of to-day are quite different from those at the beginning of the closed century.[5]

The Daltonian ideas had scarcely reached adolescence before Prout (1815), giving heed to the figures concerned, would have all the elements compounded of hydrogen. The classical atomic mass values obtained by sympathetic Stas and the numerous investigations of those who followed him, with all the refinements human ingenuity has been able to devise, temporarily silenced such speculations, but not until Marignac had halved the unit, Dumas had quartered it, and Zängerle, as late as 1882, insisted upon the one thousandth hydrogen atom.

The notion, like Banquo's ghost, will ever up, for if one may judge from the probability calculations of Mallet (*Phil. Trans.*, clxxi., 1003, 1881) and Strutt (*Phil. Mag.*, (6), i., 311), a profound truth underlies the now crude hypothesis.

Crookes (*Chem. News*, lv., 83, 1886), from observations made during prolonged and painstaking fractionations of certain of the rare earths, supported his previously announced "provisional hypothesis" as to the genesis of the elements from a hypothetical *protyle*, which existed when the universe was without form and void. He designated those intermediate entities, like yttrium, gadolinium and didymium, "meta-elements,"[1] a species of compound radicles, as it were. *Urstoff*, fire mist, protyle, the ultra-gaseous form, the fourth state of matter (Crookes, Royal Societies, June 10, 1880) was condensed by a process analogous to cooling; in short, the elements were created. The rate of the cooling and irregular condensation produced "the atavism of the elements," and this caused the formation of the natural families of the periodic system. Marignac (*Archives des Sciences Physiques et Naturelles*, 17-5; *Chemical News*, lvi., 39), criticising this hypothesis, states:—"I have always admitted[2] the impossibility of accounting for the curious relations which are manifested between the atomic weights of the elements, except by the hypothesis of a general method of formation according to definite though unknown laws; even when these relations have the character of general and absolute laws."

Further, "I do not the less acknowledge that the effect of constant association of these elements is one of the strongest proofs that can be found of the community of their origin. Besides, it is not an isolated fact; we can find other examples such as the habitual association in minerals of tantalum, niobium, and titanium."

The peculiar discharge from the negative electrodes of a vacuum tube was investigated many years ago by Hittorf and Crookes, who arrived at the conclusion that it was composed of streams of charged particles. All are familiar with the very recent proposed "electrons" and "corpuscles" resulting from the beautiful physical researches of Lodge and J. J. Thomson. These appear to have caused a trembling in the belief of many in the immutability of the atom, and the complete abandonment of the atom is seriously discussed by others.

Although by chemical means, so far, we have been unable to break up the atoms, apparently electrical energy, in the form of kathode rays, for example, follows the grain of atomic structure. Some advanced thinkers look upon the atoms as disembodied charges of electricity. Ostwald has taught it. Electric charges are known only as united to matter, yet Johnstone Stoney and Larmor, have speculated on the properties of such charges isolated. "Such a charge is inertia, even though attached to no matter, and the increase of inertia of a body due to electrification has been calculated by both Thomson and Oliver Heaviside, the conception accordingly being advanced that all inertia is electrical, and that matter, as we know it, is built up of interlocked positive and negative electrons. If it were possible in any mass of matter to separate these electrons then matter would disappear and there would remain merely two enormous charges of electricity." We are aware of phenomena attributed to the negative electrons; we await anxiously the announcement of the positive electrons.

We do know, however, as A. A. Noyes says, that "there exists in the universe some thing or things other than matter which, by association with it, give rise to the changes in properties which bodies exhibit, and give them power of producing changes in the properties of other bodies."

Shall we say, as does Remsen, "An element is a substance made up of atoms of the same kind?" Can we say that it is not? Venable (the "Definition of the Element," *Am. Chemist*, 1875, 23) truly says: "An element is best defined by means of its properties." These conceits are not exclusive. The properties are the result of the action of physical forces and chemical affinity, whatever that may be. Certain of the novel atmospheric gases have so far responded but poorly to the latter, as predicted before their discovery by Flawitzsky, Julius Thomsen and de Boisbaudran in 1887.

The following simpler definition has finally served as my guide: *An element is that which has not been decomposed, so far as we are aware, into anything other than itself.* In short, it is consistent.

We have decided to define an element by its properties. The alterations produced in the properties of the most characteristic elements by the presence of small amounts of foreign substances are evident in steel. The influence of arsenic upon the conductivity of copper is well known, and Le Bon (*Compt. rend.*, cxxxi., 706, 1900) has recently shown

[1] Abridged from an address delivered before the Section of Chemistry of the American Association by Prof. C. Baskerville.

[2] "Nature reserving these as seeds of things
Permits in them no minish nor decay:
They can't be fewer and they can't be less."

Again, of compounds—

"Decay of some leaves others free to grow
And thus the sum of things rests unimpaired."

Book ii., 79.

[3] See "The Atomic Theory, the Wilde Lecture by F. W. Clarke at Dalton Celebration, May, 1903.

[4] *Loc. cit.*

[5] While I have examined much of the original literature, Venable's "History of the Periodic Law" has been most helpful. I have, furthermore, had the privilege of reading very carefully the manuscript of a work entitled "The Study of the Atom" (in press), by Dr. Venable.

[1] Address before Chemical Section of the British Association, *Chem. News*, liv., 117, 1885.

[2] Remarks made in 1860-5 after publication of Stas's "Researches on Atomic Weights," *Archives*, ix., 102, 24-376.

that traces of magnesium (one part in 14,000) in mercury cause the latter to decompose water and to oxidise rapidly in the air at ordinary temperatures. Thorium with less than a trace of actinium produces an auto-photograph.

This point cannot be too strongly stressed in the rare earth field. One who has wrought with thorium dioxide well knows the influence a small amount of cerium has upon its solubility. The conflicting statements in the literature as to the colours of the oxides of the complexes, neodidymium and præseodidymium, cause one to wonder if different researchers have had the same hæcceity.

An appeal to the spectroscope is, of course, in the minds of all my hearers.

Grünwald, in a series of papers on his theory of spectrum analysis,[1] endeavours "to discover relations between the spectra and thus to arrive at simpler, if not fundamental 'elements.'" He came to the conclusion that "all the so-called elements are compounds of the primary elements *a* and *b*" (coronium and helium). Ames (*Am. Chem. J.*, xi., 138, 1889), having directed attention to the use of uncorrected data by Grünwald, remarks: "The concave grating gives the only accurate method of determining the ultra-violet wave-lengths of the elements; and as a consequence of not using it, most of the tables of wave-lengths so far published are not of much value."

Lockyer maintained that the lines of certain brilliant substances vary not only in length and in number, but also in brilliancy and in breadth, depending upon the quantity of the substance as well as temperature (Roy. Soc. *Proc.*, lxi., 148, 183; *Chem. News*, lxxix., 145). Being unable to decompose the elements in the laboratory, he studied the spectra of the stars. The spectra of the colder stars show many more metals, but no metalloids, whereas the coldest stars show the Crookes spectrum of metalloids which are compounds; none of the metalloids are found in the spectrum of the sun. More than 100,n00 visual observations and 2000 photographs were made in the researches.

Without doubt the spectroscopic criteria are the most valuable we have in judging finally the elements, and mayhap will remain so, but in my humble opinion, such have not alone sufficient authority, as yet, to usher the aspirant to a place among the elect. The contention frames itself, however, in an expression of the need for uniformity.

Whether we follow the most advanced metaphysico-chemical teachings or no, if there be any one concept upon which modern practical chemical thought depends, it is the law of definiteness of composition. There may be, and doubtless are, definite, perhaps invariable, properties of our elements other than their combining proportions, the atomic weights, if you please, yet, so far as we know, they approximate more closely than any fixed, if not permanent, ratios. Many of these values, by which we lay such store, are dependent upon data in which, I venture the assertion, too great confidence has been bestowed, or opinions to which sufficient attention has not been given.

As hinted at in the earlier portion of this unduly prolonged address, many have theorised as to the ultimate composition of matter. The logic of Larmor's (*Phil. Mag.*, December, 1897, 506) theory, involving the idea of an ionic substratum of matter, the support of J. J. Thomson's (*Phil. Mag.*, October, 1897, 312) experiments, the confirmation of Zeemann's phenomenon, the emanations of Rutherford, Martin's (*Chem. News*, lxxxv., 205, 1902) explanations, cannot fail to cause credence in the correctness of Crookes's idea of a fourth state of matter (*Phil. Trans.*, ii., 1881, 433). In the inaugural address as president of the British Association (1898), he acknowledges in the mechanical construction of the Röntgen ray tubes a suggestion by Silvanus Thompson to use for the antikathode a metal of high atomic weight. Osmium and iridium were used, thorium tried, and in 1896 Crookes obtained better results with metallic uranium than platinum.

These and the facts that most of the elements with high atomic weights, in fact all above 200 (thallium not reported on),[1] exhibit radio-active properties, are doubtless closely associated and have to do with the eventual composition of matter. I have unverified observations which go to show the existence of at least one element with a very high atomic weight. If it be confirmed, then we have them now or they are making, and probably breaking up, as shown by that marvellous class of elements in the discovery of which the Curies have been pioneers.

If our ideas that all known elements come from some primordial material be true, then it stands to reason that we are coming in time, perhaps, to that fixed thing, a frozen ether, the fifth state of matter. I may make use of dangerous analogy and liken our known elements, arranged in a perfected natural system, to the visible material spectrum, while electrons, &c., constitute the ultra-violet and *cosmyle* composes the infra-red, either one of the latter by proper conditions being convertible into perceptible elemental matter.

¹ "Über das Wasserspectrum- das Hydrogen. und Oxygenspectrum," *Phil. Mag.*, xxiv., 304, 1887. "Math. Spectralanalyse des Magnesiums und der Kohle." *Monatshefte für Chemie*, viii., 650. "Math. Spectralanalyse des Kadmiums," *Monatshefte für Chemie*, ix., 956.

¹ See the exquisite paper by Madame Curie on "Radio-active Substances," also "Radio-active Lead," Hofmann and Strauss. *Berichte* xxxiv., 3033, Pellini (*loc. cit.*) on "Radio-active Tellurium"; Strutt, *Phil. Mag.*, vi., 113, Elster and Geitel, Giesel, Marckwald, &c.

THE SCOPE OF GEOGRAPHY.[2]

The essential in geography is a relation between the elements of terrestrial environment and the items of organic response; this being only a modernised extension of Ritter's view. Everything that involves such a relationship is to that extent geographic. Anything in which such a relationship is wanting is to that extent not geographic. The location of a manufacturing village at a point where a stream affords water-power is an example of the kind of relation that is meant, and if this example is accepted, then the reasonable principle of continuity will guide us to include under geography every other example in which the way that organic forms have of doing things is conditioned by their inorganic environment. The organic part of geography must not be limited to man, because the time is now past when man is studied altogether apart from the other forms of life on the earth. The colonies of ants on our western deserts, with their burrows, their hills, their roads and their threshing floors, exhibit responses to elements of environment found in soil and climate as clearly as a manufacturing village exhibits a response to water-power. The different coloration of the dorsal and ventral parts of fish is a response to the external illumination of our non-luminous earth. The word *arrive* is a persistent memorial of the importance long ago attached to a successful crossing of the shore line that separates sea and land. It is not significant whether the relation and the elements that enter into it are of easy or difficult understanding, nor whether they are what we call important or unimportant, familiar or unfamiliar. The essential quality of geography is that it involves relations of things organic and inorganic; and the entire content of geography would include all such relations.

Thus defined, geography has two chief divisions. Everything about the earth or any inorganic part of it, considered as an element of the environment by which the organic inhabitants are conditioned, belongs under physical geography or physiography.[3] Every item in which the organic inhabitants of the earth—plant, animal or man—show a response to the elements of environment, belongs under organic geography. Geography proper involves a consideration of relations in which the things that belong under its two divisions are involved.

Geography is, therefore, not simply a description of places; it is not simply an account of the earth *and* of its inhabitants, each described independently of the other; it involves a relation of some element of physical geography to some item of organic geography, and nothing from which this relation is absent possesses the essential quality of geographical discipline. The location of a cape or of a city is an elementary fact which may be built up with other facts into a relation of full geographic meaning; but taken alone, it has about the same rank in geography that spelling has in language. A map has about the same place in geography

² Abridged from an address delivered before the Section of Geology and Geography of the American Association by Prof. W. M. Davis

³ It should be noted that the British definition of physiography gives it a much wider meaning than is here indicated.

that a dictionary has in literature. The mean annual temperature of a given station, and the occurrence of a certain plant in a certain locality, are facts of kinds that must enter extensively into the relationships with which geography deals; but these facts, standing alone, are wanting in the essential quality of mature geographical science. Not only so; many facts of these kinds may, when treated in other relations, enter into other sciences; for it is not so much the thing that is studied as the relation in which it is studied that determines the science to which it belongs.

There can be no just complaint of narrowness in a science that has charge of all the relations among the elements of terrestrial environment and the items of organic response. Indeed, the criticism usually made upon the subject thus defined is, as has already been pointed out, that it is too broad, too vaguely limited and too much concerned with all sorts of things to have sufficient unity and coherence for a real science. Some persons, indeed, object that geography has no right to existence as a separate science; that it is chiefly a compound of parts of other sciences; but if it be defined as concerned with the relationships that have been just specified, these objections have little force. It is true, indeed, that the things with which geography must deal are dealt with in other sciences as well, but this is also the case with astronomy, physics, chemistry, geology, botany, zoology, history, economics, and other sciences. There is no subject of study the facts of which are independent of all other subjects; not only are the same things studied under different sciences, but every science employs some of the methods and results of other sciences. The individuality of a science depends not on its having to do with things that are cared for by no other science, or on its employing methods that are used in no other science, but on its studying these things and employing these methods in order to gain its own well-defined object. Chemistry, for example, is concerned with the study of material substances in relation to their constitution, but it constantly and most properly employs physical and mathematical methods in reaching its ends. Botanists and zoologists are much interested in the chemical composition and physical action of plants and animals, because the facts of composition and action enter so largely into the understanding of plants and animals considered as living beings. Overlappings of the kind thus indicated are common enough, and geography, as well as other sciences, exhibits them in abundance. It may be that geography has a greater amount of overlapping than any other science; but no valid objection to its content can be made on that ground; the maximum of overlapping must occur in one science or another—there can be no discredit to the science on that account. Geography has to do with rocks the origin of which is studied in geology; with the currents of the atmosphere, the processes of which exemplify general laws that are studied in physics; with plants and animals, the forms and manner of growth of which are the first care of the botanist and zoologist; and with man, whose actions recorded in order of time occupy the historian; but the particular point of view from which the geographer studies all these things makes them as much his own property as they are the property of anyone else.

SOME UNSOLVED PROBLEMS OF ORGANIC ADAPTATION.[1]

The recent impulse which has come to biologic progress by experimental methods, and the remarkable results which have been attained thereby, may without exaggeration be said to have raised anew many an earlier doubt as well as brought to light problems apparently beyond the scope of the older explanations. It may not, therefore, be an extravagant assumption to announce the entire question of organic adaptations as open for reconsideration, in the light of which no apology will be necessary for directing attention to certain phases of the subject upon the present occasion.

Among the many problems which recent investigations and conclusions have brought into better perspective as well as sharper definition, and which might profitably be discussed, the limits of a single address preclude any very wide range of review. I have, therefore, chosen to restrict my discussion chiefly to problems of coloration among lower invertebrates, including incidental references to correlated subjects, and the probable limitations of colour as a factor in organic adaptation.

As is perfectly well known, colour in nature is due to one of two causes, or to a combination of both, namely, (1) what has been termed optical or structural conditions, such as diffraction, interference or unequal reflection of light, examples of which are familiar in the splendid hues of the rainbow, the iridescent sheen and metallic colours of the feathers of many birds, wings of insects, &c. (2) What are known as pigmentary colours, due to certain material substances lodged within the tissues of animals or plants which have the property of absorbing certain elements of light and of reflecting others, and thereby producing the sensation of colour. While the two are physically quite distinct it is not unusual to find them associated in producing some of the most exquisite colour effects of which we have knowledge. In a general way one may usually distinguish between these two sorts of colour by noting that those which are purely optical in their character produce a constantly changing impression as the relative position of object or observer may happen to vary with reference to the angle and direction of light; while, upon the other hand, colours which are due to pigments show this property very slightly or not at all, and that, moreover, pigment colours are usually more or less soluble in various reagents, such as alcohol, ether, acids, alkalies, &c., and that they often fade rapidly under the influence of strong light or in its absence, or upon the death of the organism.

The work of Krukenburg, MacMun, Macallum, M'Kendric, Hopkins, Urech, Eisig, Cunningham, and a host of others, comprising a mass of literature of enormous proportions, will be available to those interested, and may afford some faint conception of the magnitude and importance of the field to be explored, as well as an introduction to that already made available. And while as a result of this activity many and various organic pigments have been isolated and their composition in part or entirely made known, it must be recognised that the task of the chemical analysis of any such highly complex compounds as most of these are known to be is attended with extreme difficulty and no small measure of uncertainty. Still, it has been possible fairly to distinguish several classes of such pigments, differentiated physiologically as follows:—

(1) Those directly serviceable in the vital processes of the organism. Under this head may be classed such pigments as hæmoglobin, chlorophyll, zoonerythrin, chlorocruorin, and perhaps others less known. It need not be emphasised that by far the most important of these are the two first named. The others, found chiefly among the lower invertebrates, are believed to serve a function similar to the first.

(2) Waste products. Among these the several biliary products are too well known to call for special note. Guanin is a pigment of common occurrence in the skin of certain fishes, and is associated with the coloration of the species. Similarly certain colouring matters have been found in the pigments of many Lepidoptera, known as lepidotic acid, a substance closely allied to uric acid, and undoubtedly of the nature of a waste product.

(3) Reserve products. Of these there are several series, one of which, known as lipochrome pigments, is associated with the metabolism involved in the formation of fats and oils. Perhaps of similar character are such pigments as carmine, or rather cochineal, melanin, &c. It may be somewhat doubtful whether these pigments do not rather belong to the previous class, where should probably be listed such products as hæmatoxylin, indigo, &c., all of which have been claimed as resultants of destructive metabolism in process of being eliminated from the physiologically active tissues of the body of the organism. Of similar character is probably tannic acid, a substance well known among plant products and involved in the formation of many of the brownish and rusty colours of autumn foliage, particularly of the oaks and allied trees, as are the lipochromes in the formation of the reds and yellows which form so conspicuous a feature among autumn colours.

While the association of these and other pigmentary matters has long been known in connection with both animal and plant growth, and while the conception of their more or less intimate relation to the active metabolism of the various tissues is not new, comparatively little has been

[1] Abridged from an address delivered before the Section of Zoology of the American Association by Prof. C. W. Hargitt.

done toward directly investigating and elucidating the exact nature and extent of the process. This seems to be especially the case in relation to the part played by these products in the formation of those features of coloration among organisms with which we are now concerned.

From considerations of researches connected with various organisms three things seem to be more or less evident :—

(1) That in all regenerative processes a very marked degree of metabolism is involved, whether in the mere metamorphosis of old tissues into new, or in the direct regeneration of new tissues by growth processes, both of which seem to occur.

(2) That in regenerative processes there is often associated the development of pigmentary substances which seem to have no direct function in relation thereto.

(3) That in many cases there follows a more or less active excretion and elimination of portions of the pigment in question.

In the present review I have not in the least sought to ignore or discredit the value of natural selection as a factor in organic evolution. Nor would I be understood as wholly discarding colour as a factor in organic adaptation, particularly among the higher and more specialised forms, but rather to show its limits. At the same time I must submit to a growing conviction that its importance has been largely overestimated, and that other factors have been as largely lost sight of. If the present discussion may serve in even the smallest degree to direct attention to some of the latter it will have served its chief purpose.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—An examination in tropical medicine and hygiene will be held during the year 1904. The examination will begin on August 9, and extend over three days. The examination will have reference to the nature, incidence, prevention, and treatment of the epidemic and other diseases prevalent in tropical countries. Every candidate who passes the examination to the satisfaction of the examiners will receive from the university a diploma testifying to his knowledge and skill in tropical medicine and hygiene. All applications for information respecting the examination should be addressed to Mr. G. H. F. Nuttall, Pathological Laboratory, Cambridge.

THE Education Committee of the Manchester City Council has unanimously resolved to recommend that a grant of 4000*l.* be given from the city rates in aid of the University of Manchester.

IT is announced in *Science* that Prof. John Hays Hammond has added 10,000*l.* to his previous gift of 10,000*l.* for a metallurgical laboratory of Yale University, and that by the will of the late James A. Woolson Boston University will ultimately receive 120,000*l.*, Radcliffe College 60,000*l.*, and the Wesleyan Academy at Wilbraham, Mass., 60,000*l.*

MR. P. N. RUSSELL, who for many years carried on extensive engineering works in Sydney, but has latterly resided in London, has made a further donation of 50,000*l.* for an additional endowment to the School of Engineering at the University of Sydney. Mr. Russell originated this school about seven years ago by an endowment of 50,000*l.*

LORD KELVIN will distribute the prizes at the Northampton Institute, London, on Friday, February 26. The students' conversazione will be held on the same evening, and will be continued on the evening of Saturday, February 27, when the building will be thrown open to the whole of the members and students of the institute and their friends.

THE annual report of the Carnegie Trust for the universities of Scotland was submitted to the trustees at their third annual meeting, which was held in London on Friday last. The report states that the scheme of allocation for five years of an annual grant of 40,000*l.* among the four Scottish universities became operative on January 1, 1903. Of the grant for the year ended December 31, 1903, sums amounting to 20,325*l.* have been claimed and handed over. One chair has been founded and its first occupant appointed —the Burnett Fletcher chair of history and archæology in the University of Aberdeen. Of the sum of 20,000*l.* required for the endowment of this chair, donations amounting to about 12,000*l.* have been received from the Burnett trustees, Mrs. Fletcher, and others. The ordinance instituting a chair of geology in the University of Glasgow has been approved by Parliament, and it is expected that a professor will be appointed before next winter session, when the accumulations in hand of the annual grant of 2000*l.* assigned towards the endowment of this chair will be available, together with such portion of the future annual grants as may be needed to complete the endowment fund of 15,000*l.*, half of which is provided by the Bellahouston trustees and others. In the University of St. Andrews two lectureships—in French and in botany—have been established, each with an endowment of 10,000*l.* Under the scheme of endowment of post-graduate study and research the committee has made the first awards. The estimated outlay under this head for the academic year 1903–4 is 3524*l.*, of which the sum of 1828*l.* was expended within the year 1903. The committee has entered into an agreement with the Royal College of Physicians of Edinburgh by which the trust has purchased the property and laboratory of the college in Forrest Road, Edinburgh, for 10,000*l.*, on the understanding that the College of Physicians and the College of Surgeons continue their present annual contributions of 750*l.* and 200*l.* respectively to the working of the laboratory.

THE second annual report of the executive committee in connection with the fund for advanced university education and research at University College, London, was presented at the annual general meeting of the members of the college on February 24. It will be remembered that the two main purposes of the fund are :—(1) to raise the sum of 200,000*l.* to bring about the incorporation of University College in the University of London, and thus to promote the unification of university studies in London; (2) To provide the sum necessary to equip and endow University College adequately for its work as an integral part of the University of London. For this purpose it was estimated that a capital sum of 800,000*l.* was required, or an income corresponding to such capital sum. For the first of these purposes the committee has raised 141,000*l.*, leaving a balance of 59,000*l.* necessary to enable the conditions of incorporation to be fulfilled. Since August 31, 1903, a most important addition has been made to the fund owing to the munificence of an anonymous donor, who, through Prof. E. H. Starling, F.R.S., and Dr. Page May, promised the sum of 50,000*l.* This sum, together with additional subscriptions received since the date mentioned, brings the total amount raised up to 167,287*l.*, of which 141,000*l.* is available for the purpose of incorporation and the balance of 26,000*l.* for the endowment and equipment of the college. It will be seen that while considerable progress has been made, much remains to be done to realise the whole scheme. It is desirable that the remainder of the money necessary for incorporation should be raised without delay in order to make it possible for a Bill to be introduced in the House of Commons next session. The report of the council of University College presented on the same occasion contains, in addition to full financial statements for the year 1902–1903, an exhaustive list of original papers and other publications completed by members of the staff of the college during the same period, and also particulars of the post-graduate courses of lectures and laboratory work during the present session.

THE secretaries of the Royal Society have addressed a letter to the Vice-Chancellor of the University of Oxford directing attention to a resolution adopted by the president and council of the Royal Society :—"That the universities be respectfully urged to consider the desirability of taking such steps in respect of their regulations as will, as far as possible, ensure that a knowledge of science is recognised in schools and elsewhere as an essential part of general education." Enclosed with the letter was a statement regarding scientific education in schools, drawn up by a committee of the Royal Society, and both are printed in the *Oxford University Gazette*. The statement points out that "it still remains substantially true that the public schools have devised for themselves no adequate way of assimilating

into their system of education the principles and methods of science," and goes on to urge that the universities can do much to promote and encourage improvement in these matters. It is suggested that the universities might expand and improve their general tests, so as to make these correspond with the education, both literary and scientific, which a student, matriculating at the age of nineteen years, should be expected to have acquired. Commenting on these communications from the Royal Society, Prof. Case, in a letter to the *Times*, remarks "that the real contention is that while Greek is not, 'science' is, an essential part of general education." But as his letter shows, Prof. Case means by "science" some single subject such as mechanics, whereas the Royal Society is pleading for instruction in the methods of science. It may fairly be asserted that no general education can be complete in which scientific method takes no part; yet, in the past, there has been a compulsory examination in Greek and none in science. Though men of science do not ask for compulsory examinations in single subjects of science, nor advocate these as essential parts of the school curriculum, yet they urge strongly that the spirit of scientific observation and inquiry should be fostered because it promotes both the material and the intellectual progress of the nation.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, June 18, 1903. (Received in revised form January, 1904.)—"The Longitudinal Stability of Aerial Gliders." By G. H. **Bryan**, Sc.D., F.R.S., and W. E. **Williams**, B.Sc., University College of North Wales.

The object of the investigations was (1) to show that the longitudinal stability of aëroplane systems *can* be made the subject of mathematical calculation; (2) to direct the attention of those interested in the problem of artificial flight to the necessity of acquiring further experimental knowledge concerning the quantities on which this stability is shown to depend.

The conclusions reached were as follows:—

(1) For a glider or other body moving in a vertical plane in a resisting medium of any kind whatever, the small oscillations about a state of uniform rectilinear motion are determined by an equation of the fourth degree, so that the conditions for stable steady motion are those obtained by Routh.

(2) The coefficients in the period equation involve, in addition to the ordinary dynamical constants, nine quantities X_u . . G_θ, which, when referred to rectangular axes fixed in the body, represent the differential coefficients of the forces and couple due to the aërial resistances with respect to its translatory and rotatory velocity components.

(3) In the case of a system of aëroplanes these nine quantities can be expressed for the separate planes in terms of $f'(\alpha)$ and $\phi'(\alpha)$, where $f(\alpha)$ and $\phi(\alpha)$ are functions determining the resultant thrust, and the position of the centre of pressure when the direction of the relative motion of the air makes an angle α with the plane. These functions have been tabulated for certain different forms of surfaces, but further data are greatly needed.

(4) *The longitudinal stability of the gliders is thus seen to be capable of mathematical investigation*, and it is of paramount importance that the present methods should be practically applied to any aërial machines that may be designed or constructed before any actual glides are attempted.

(5) The methods of calculation are exemplified by numerical determinations of the criterion of stability in the cases of a single plane lamina, and a pair of planes one behind the other. Most of the calculations have been performed for an angle of gliding of 10° with the horizon, and it has been necessary to assume arbitrary values for the moment of inertia of the lamina.

(6) The condition that any steady linear motion may be stable in all these cases assumes the form $V^2 \cdot ka$, where a is a constant depending on the linear dimensions of the glider, and k is a constant depending on its shape, the angle of gliding and the law of aërial resistance.

(7) For a pair of narrow slats, in which the variations in the positions of the centres of pressure of each are neglected, certain coefficients of stability vanish if the slats are in the same plane. If the planes are square so that the displacements of the centres of pressure are not neglected, the system is in general less stable than a single square plane.

(8) By inclining the planes at a small angle to each other the stability is much increased. On the other hand, if they are made to slope away from each other, the glider becomes unstable.

(9) Two square planes of equal size placed one behind the other at a small angle are less stable in the examples considered than a square of the same size as one of the two, but more stable than a single square the side of which is equal to the total length of the glider formed by the pair.

(10) A pair of unequal squares of which the smaller forms a rudder are more stable, in the examples considered, when gliding with the rudder behind than with the rudder in front.

(11) In the examples considered stability is increased by decreasing the moment of inertia of the glider.

February 4.—"Cultural Experiments with 'Biologic Forms' of the Erysiphaceæ." By Ernest S. **Salmon**, F.L.S. Communicated by Prof. H. Marshall Ward, F.R.S.

The author points out that through specialisation of parasitism "biologic forms" have been evolved in the Erysiphaceæ, and that the powers of infection, characteristic of each "biologic form," are under normal conditions sharply defined and fixed. Hitherto the result of the experiments of numerous investigators—both with regard to the present group of fungi and to the Uredineæ, where the same specialisation of parasitism occurs—has been the accumulation of evidence tending to emphasise the immutability of "biologic forms."

In a series of cultural experiments with "biologic forms" of *Erysiphe Graminis*, DC., the author has discovered that under certain methods of culture, in which the vitality of the host-leaf is interfered with, the restricted powers of infection, characteristic of "biologic forms," break down.

In these cultural experiments the leaf, previous to inoculation, was injured by the removal of a minute piece of leaf-tissue, or by touching the epidermis with a red-hot knife. The experiments proved that the range of infection of a "biologic form" becomes increased when the vitality of a leaf is affected by injury, so that the conidia of certain "biologic forms" are able to infect injured leaves of host-species which are normally immune against their attacks.

Further experiments showed that the conidia of the fungus produced on a "cut" leaf are able at once to infect uninjured leaves of the same host-species.

The author suggests that injuries to leaves, caused in nature by hail, storms of wind, attacks of animals, &c., may produce the same effect as the artificial injuries described above in rendering the injured leaf susceptible to a fungus otherwise unable to infect it.

Attention is directed to the close parallel between the behaviour of the fungus in the experiments and the biological facts obtaining in the class of parasitic fungi known as "wound parasites" (Nectria, *Peziza willkommii*, &c.).

"On the Effects of Joining the Cervical Sympathetic Nerve with the Chorda Tympani." By J. N. **Langley**, F.R.S., and H. K. **Anderson**, M.D.

The experiments have been directed to determine whether the cervical sympathetic, if allowed an opportunity of becoming connected with the peripheral nerve cells in the course of the chorda tympani, will in part change their function from vaso-constrictor to vaso-dilator. The superior cervical ganglion in an anæsthetised cat was excised and the central end of the cervical sympathetic nerve was joined to the peripheral end of the lingual, which contains the chorda tympani fibres. After allowing time fur union and regeneration of the nerves, the cervical sympathetic was stimulated; it caused prompt flushing of the sub-maxillary glands, and the effect was repeatedly obtained.

The experiment shows (1) that vaso-constrictor nerve fibres are capable of making connection with peripheral vaso-dilator nerve cells, and becoming vaso-dilator fibres, and (2) that whether contraction or inhibition of the un-

striated muscle of the arteries occurs on nerve stimulation depends upon the mode of nerve-ending of the post-ganglionic nerve fibre.

The cervical sympathetic gave a less scanty and more prolonged secretion than normal, so that some of its nerve fibres had become connected with the peripheral secretory nerve cells of the chorda tympani.

Geological Society, January 20.—Sir Archibald Geikie, Sec.R.S., vice-president, in the chair.—On the jaws of Ptychodus from the Chalk: Dr. A. Smith **Woodward**, F.R.S. Hitherto no traces of the cartilaginous jaws of this fish have been found in association with the dentition, but recently a specimen of *Ptychodus decurrens* has been found in the zone of *Holaster subglobosus* of the Lower Chalk at Glynde. Fragmentary remains of both jaws are seen in the specimen, each bearing characteristic teeth arranged in natural order. There are four series, and one small displaced tooth (probably belonging to the fifth series), on the left of the large median series in the lower jaw, while in the upper jaw the teeth are arranged in six paired series. The specimen proves that Ptychodus resembles the Trygonidæ in its jaws. The probable explanation of the new discovery is that in the Cretaceous period the great rays of the "families" Myliobatidæ and Trygonidæ had not become fully differentiated. Prof. Jækel has proposed to place all these fishes in one family, termed Centrobatidæ. If this arrangement be adopted, Ptychodus represents a primitive subfamily, which still awaits definition, while the Trygoninæ, Myliobatinæ, and Ceratopterinæ are equivalent subfamilies which still survive.—On the igneous rocks at Spring Cove, near Weston-super-Mare: W. S. **Boulton**. A traverse from end to end of the exposure at the locality shows that the "basalt-mass" is by no means a simple lava-flow. It may be roughly divided into three portions. Beginning at the cliff-end to the north, the rock is a pillowy basalt, with tuff and limestone; then the rock is mainly a coarse "agglomerate," with lapilli and bombs of basalt and limestone; while the remaining part is a basalt-coulée, with few small lumps of burnt limestone. The limestone below is reddened and altered, and does not contain lapilli; the limestone above contains lapilli. The pillowy basalt probably represents a river of agglomeratic material possibly ejected from a vent. The intervening tuff may present an analogy with the "volcanic sand" of the West Indian eruptions. There is no evidence of the quiet deposition of ashy material. The large fragments of limestone found mainly in the lower part of the basalt-mass have not come in from above, but seem to have been picked up from the sea-bed in which it had been accumulating, and to have been involved with and altered by the volcanic material.

February 3.—Sir Archibald Geikie, Sec.R.S., vice-president, in the chair. On a deep-sea deposit from an artesian boring at Kilacheri, near Madras: Prof. H. Narayana **Rau**. The boring, after penetrating the upper clays and sandstones, passed through carbonaceous shales, and at a depth of about 400 feet reached a blue homogeneous rock, effervescing with acid, and showing radiolarian tests under the microscope. One or two specimens of foraminifera have also been seen. The deposit underlies beds of the Upper Gondwána stage. The author concludes that the deposit is of abysmal origin, similar to those described in the *Challenger* reports. In the discussion that followed Dr. W. T. Blanford said that he was unable to agree with the author's conclusions, and he objected to the title of the paper, because the rocks described were, in his opinion, not deep-sea deposits. The mineral evidence brought forward was quite insufficient to show that the beds were oceanic, and the presence of radiolaria was no proof by itself of deep-sea conditions.—The Rhætic beds of the South Wales direct line: Prof. S. H. **Reynolds** and A. **Vaughan**. After a reference to the literature of the subject the following exposures are described—the Stoke-Gifford and the Lilliput or Chipping-Sodbury sections.

Entomological Society, February 3.—Prof. E. B. Poulton, F.R.S., president, in the chair.—Mr. A. J. **Chitty** exhibited two specimens of *Ptinus tectus*, Boisd., taken by him in a granary in Holborn in the winter of 1892–3, also a complete series of the red Apions to show *A. sanguineum* from the late Frederick Smith's collection.—Mr. O. E. **Janson** exhibited specimens of *Papilio weiskei*, Ribbe, and *Troides meridionalis*, Rothschild, recently taken by Mr. A. S. Meek near the Arna River in the interior of British New Guinea.—Mr. E. C. **Bedwell** exhibited the following species of Coleoptera taken by him in north Wales (on Snowdon) in the first week of August, 1903:—a fine series of *Chrysomela cerealis*, L., a pair of them being of the curiously dull form, *Anthophagus alpinus*, Payk., *Acidota crenata*, F., *Arpedium brachypterum*, Grav.; and *Quedius longicornis*, Kr., hitherto unrecorded from the Principality.—The Rev. F. D. **Morice** exhibited a series of lantern slides illustrating the structure of concealed ventral segments in males of the hymenopterous genus Colletes.—Mr. W. J. **Kaye** exhibited a Müllerian association of black and transparent species from the Potaro Road, British Guiana, consisting of Ithomiinæ, *Ithomia zarepha*, *Ithomia florula*, *Heterosais sylphis*, and Napeogenes, n.sp., Erycinidæ, *Stalachtis phaedusa*, and *Stalachtis evelina*, Hypsidæ, *Lauron partita*, Geometridæ, Hyrmina, n.sp. The whole of the specimens had been caught on one single forest road, some 170 miles inland. Mr. Kaye directed particular attention to the new species of Napeogenes, and said it was a most remarkable divergence from the usual coloration of the genus Napeogenes as a whole, where orange-yellow and black were the prevailing colours, while the present insect was black and transparent only, and conformed in a wonderful way with many true members of the genus Ithomia.—The **President** exhibited a male and female of *Papilio dardanus*, captured by Mr. Geo. F. Leigh at Durban in 1902, and examples of the offspring reared from the eggs laid by the female. The latter was of the *cenea* form, as were the great majority of the female offspring; three, however, were of the black and white *hippocoon* form. More recently, in 1903, Mr. Leigh had captured a female of the rare *trophonius* form, and had bred from the seven eggs laid by it five butterflies, of which the two females were both of the commonest *cenea* form. The female *trophonius* was also exhibited, together with the five offspring.—Captain C. E. **Williams** read a paper on the life-history and habits of *Gongylus gongyloides*, a mantis of the tribe Erupasides and a floral simulator, and exhibited a living ♀ in the nymph stage, together with coloured drawings, photographs, and lantern slides showing both the adult and immature insect in various positions. The chief features of interest in the exhibitions lay in the peculiar modifications of shape and colouring by which this mantis conceals itself and attacks its prey, which consists of Lepidoptera and Diptera.—Mr. G. A. J. Rothney communicated descriptions of new species of Cryptinæ from the Khasia Hills, Assam, and a new species of Bembex, by Peter **Cameron**.—Mr. M. **Burr** contributed systematic observations upon the Dermatoptera.—Dr. T. A. **Chapman** read a paper on a new species of Heterogynis, and exhibited specimens of this and other allied species.—Mr. R. **Trimen**, F.R.S., read a paper on some new or imperfectly known forms of South African butterflies, and exhibited, among other specimens, illustrating his remarks, typical and aberrational forms of *Acraea rahira*, *Zeritis felthami*, a new species, *Z. molome*, Trim., and *Z. damarensis*, Trim.; typical *Colias electra*, Linn., from Natal, and a remarkable melanic aberration of the same species; also *Kedestas tucusa*, a very rare and unfigured Hesperiid ♀ and ♂ from Johannesburg.

PARIS.

Academy of Sciences, February 15.—M. Mascart in the chair.—The president announced to the academy the death of M. Callandreau, member of the section of astronomy.—On the simple fundamental solution and the asymptotic expression of temperature in the problem of cooling: J. **Boussinesq**. The action of reduced nickel in the presence of hydrogen on halogen derivatives of the fatty series: Paul **Sabatier** and Alph. **Mailhe**. It has been shown in a previous paper that in the aromatic series the halogen may be readily replaced by hydrogen by the action of reduced nickel. In the fatty series the action is quite different; the saturated hydrocarbon is not produced, but the alkyl chloride is broken up into hydrochloric acid and the corresponding olefine, these partially recombining, giving secondary and tertiary chlorides where possible. Methyl

chloride behaves in an exceptional manner, giving hydrochloric acid, hydrogen, and carbon. The behaviour of bromine and iodine derivatives is generally similar to that of the chlorine compounds, methyl iodide being exceptional, giving methane and a little ethylene.—On quasi-rational numbers, and ordinary or continued quasi-periodic arithmetical fractions: Edmond **Maillet.**—On the actinium radiation: A. **Debierne.** A detailed study of the law of disappearance of the emanation of actinium, and also of the decrease of radio-activity induced by this emanation.—The phenomenon of the transmission of the n-rays and its applications: Augustin **Charpentier.**—A description of a series of experiments on the conduction of the n-rays along copper and silver wires. A piece of string, moistened with collodion containing calcium sulphide in suspension, also conducts like a metallic wire.—On the conditions of the indifferent state: E. **Ariès.**—On the influence of complex ions in electrolysis by alternating currents: André **Brochet** and Joseph **Petit.** With alternating currents there may be the formation of complex ions, disengagement of detonating gas, solution of the electrodes, or oxidation or reduction in cases where the electrolyte is capable of oxidation or reduction.—On γ-chloroacetoacetic ester: M. **Lespieau.** This substance has been previously only obtained mixed with an isomer; by the oxidation of

$$CH_2Cl.CH(OH).CH_2.CO_2C_2H_5$$

by a mixture of potassium bichromate and dilute sulphuric acid which furnishes the ketonic ester in a pure state. It is characterised by its copper salt, which is insoluble in water, but can be crystallised from benzene.—On dichloromethylenedioxypropylbenzene and the carbonate of propylpyrocatechin: R. **Delange.** The halogen compound is obtained by the interaction of phosphorus pentachloride and dihydrosafrol, and is separated by distillation in a vacuum. It enters very readily into reactions, details of those with water, alcohol, phenol, acetic anhydride, and acetic acid being given.—On the glyoxylic ureides: allantoin and allantoic acid: L. J. **Simon.**—Some observations in the composition of potato starch: A. **Fernbach.** Phosphoric acid is an integral constituent of starch grains. Potato starch was separated by levigation into several fractions, corresponding to grains of varying size, and the amount of phosphate in each fraction determined. From the analytical figures thus obtained the conclusion is drawn that the nucleus of each grain is relatively rich in phosphorus, and upon this are gradually superposed layers of starch free from phosphorus.—On a new copal resin and kino, the first furnished by the fruit, the second by the bark of *Dipteryx odorata*: Édouard **Heckel** and Fr. **Schlagdenhauffen.**—Varieties of origin, nature and properties of the soluble active products developed in the course of a bacterial infection: A. **Charrin.**

DIARY OF SOCIETIES.

THURSDAY, FEBRUARY 25.

ROYAL SOCIETY, at 4.30.—Electromotive Phenomena in Mammalian Non-medullated Nerve: Dr. N. H. Alcock.—Further Observations on the *Rôle* of the Blood-Fluids in connection with Phagocytosis: Dr. A. E. Wright and Capt. S. R. Douglas.—On Mechanical and Electrical Response in Plants: Prof. J. C. Bose.—On the Compressibility of Solids: J. Y. Buchanan, F.R.S.—A Contribution to the Pharmacology of Indian Cobra-venom: Major R. H. Elliot.

ROYAL INSTITUTION, at 5.—Electrical Methods of Measuring Temperature: Prof. H. L. Callendar, F.R.S.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Transatlantic Engineering Schools and Engineering: Dr. R. M. Walmsley. (Adjourned Discussion.)

FRIDAY, FEBRUARY 26.

ROYAL INSTITUTION, at 9.—New Developments in Electric Railways: Alex. Siemens.

PHYSICAL SOCIETY, at 5.—A New Dilatometer: B. Bonniksen.—A Quartz-thread Vertical Force Magnetograph: Dr. W. Watson, F.R.S.—On Stresses in a Magneto-static Field: G. W. Walker.—Some Hints on the Preparation of Diagrams: Dr. W. Watson, F.R.S.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Boiler-house Design: L. G. Crawford.

SATURDAY, FEBRUARY 27.

ROYAL INSTITUTION, at 3.—The Life and Work of Stokes: Lord Rayleigh.

ESSEX FIELD CLUB, at 6.30 (at the Essex Museum of Natural History, Stratford).—A Disappearing Industry; Charcoal Burning in Essex: T. S. Dymond.—Recent Observations and Discoveries concerning London City Walls, the Walbrook and Moorfields: F. W. Reader.

MONDAY, FEBRUARY 29.

SOCIETY OF ARTS, at 8.—Modern Book Printing: Charles T. Jacobi. (Cantor Lecture, II).

INSTITUTE OF ACTUARIES, at 5.—An Investigation into the Rates of Re-Marriage and Mortality amongst Widows in Receipt of Relief from the Patriotic (Russian War) Fund, 1854–1900: J. Burn and J. McDonald.

TUESDAY, MARCH 1.

ROYAL INSTITUTION, at 5.—Japanese Life and Character: E. Foxwell.

SOCIETY OF ARTS, at 4.30.—Nigeria: Lady Lugard (Miss Flora L. Shaw).

ZOOLOGICAL SOCIETY, at 8.30.

INSTITUTION OF CIVIL ENGINEERS, at 8.—*Papers to be further discussed*: The Construction of Railway-Wagons in Steel: J. D. Twinberrow.—The Construction of Iron and Steel Railway-Wagons: A. L. Shackleford.—Iron and Steel Railway-Wagons of High Capacity: J. T. Jepson.

WEDNESDAY, MARCH 2.

SOCIETY OF ARTS, at 8.—Physical Degeneration: Dr. Robert Jones.

ENTOMOLOGICAL SOCIETY, at 8.—Notes on Australian and Tasmanian Cryptocephalides, with descriptions of New Species: A. M. Lea. A Revision of the Sub-family Pelidnotinæ of the Coleopterous family Rutelidæ, with descriptions of New Genera and Species: the late Frederick Bates, communicated by G. J. Arrow.—On some New Species of Eastern Australian and African Moths in the British Museum: Colonel C. Swinhoe.—An Entomological Excursion to Mencayo, Spain: G. C. Champion; with some Remarks on the Habits of *Xyleborus dispar.*, Fabr.: Dr. T. A. Chapman: Further Notes on Hydroptilidæ belonging to the European Fauna, with descriptions of New Species: K. J. Morton.—*Discussion*: What is a Species? Prof. E. B. Poulton, F.R.S., Mr. H. J. Elwes, F.R.S., Dr F. A. Dixey and others.

THURSDAY, MARCH 3.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: An Inquiry into the Nature of the Relationship between Sunspot Frequency and Terrestrial Magnetism: Dr. C. Chree, F.R.S.—The Optical Properties of Vitreous Silica: J. W. Gifford and W. A. Shenstone, F.R.S.—A Radial Area Scale: R. W. K. Edwards.—The Origin of the Flutings in the Spectra of Antarian Stars: A. Fowler.

ROYAL INSTITUTION, at 5.—Electrical Methods of Measuring Temperature: Prof. H. L. Callendar, F.R.S.

RÖNTGEN SOCIETY, at 8.30.—Presidential Address: Some Laboratory Notes of the last Six Months.

LINNEAN SOCIETY, at 8.—List of the Species of Carex known to occur in Malaya: C. B. Clarke, F.R.S.—On some Species of the Genus Palæmon, Fabr., from Tahiti, Shanghai, New Guinea, and West Africa: Dr. J. G. de Man.

CHEMICAL SOCIETY, at 8.—Chemical Dynamics of the Alkyl Iodides: Miss K. A. Burke and F. G. Donnan: The Constitution of Phenolphthalein: A. G. Green and A. G. Perkin.—δ-Ketohexahydrobenzoic Acid: W. H. Perkin, junr.—Photochemically active Chlorine: C. H. Burgess and D. L. Chapman.

FRIDAY, MARCH 4.

ROYAL INSTITUTION, at 9.—Breathing in Living Things: Prof. W. Stirling.

SATURDAY, MARCH 5.

ROYAL INSTITUTION, at 3.—The Life and Work of Stokes: Lord Rayleigh.

CONTENTS.

THURSDAY, MARCH 3, 1904.

THE HISTORY OF ELEMENTARY MATHEMATICS.

Geschichte der Elementar-Mathematik in systematischer Darstellung. By Dr. Johannes Tropfke. Zweiter Band. Pp. viii + 496. (Leipzig: Veit and Co., 1903.)

IN his first volume of this work, already reviewed in NATURE, Dr. Tropfke confined himself to the history of elementary arithmetic and algebra. He has now completed his work by giving with equal care, and the same wealth of references, the story of the progress of the other branches of elementary mathematics—geometry, logarithms, plane and spherical trigonometry, series, stereometry, analytical geometry, and a few other topics of minor importance.

To geometry 140 pages are devoted, besides the chapters on conics and analytical geometry; this is not very much, and some paragraphs are so condensed that a large part of them consists of titles. But the arrangement is good, and on several points very interesting details are given. Thus we have side by side, and in the original, the definitions of Euclid and those of Hero of Alexandria. The comparison of the two sets is instructive; thus Hero adds to the bare definition of a line (*i.e.* curve) a statement of its genesis by an ideal point continuously moving in space (*γίγνεται δὲ σημείου ῥυέντος ἄνωθεν κάτω ἐννοίᾳ τῇ κατὰ συνέχειαν*). Similarly he adds to Euclid's definition of a straight line another definition of it as the shortest line joining two points. In translating Euclid's definition of a straight line, Dr. Tropfke renders the very difficult phrase *ἐξ ἴσου* by "gleichmässig (in derselben Anordnung und Richtung)," where, of course, the parenthesis is the translator's gloss, and probably puts more into the definition than Euclid intended. Perhaps "symmetrically," as we use the term, is the nearest equivalent. Whatever is proposed, it must be remembered that the current version in English editions of the "Elements" is a mistranslation. Euclid says nothing about the extreme points of the line; he says "a straight line is one which lies *ἐξ ἴσου* with respect to the points on it," that is, to *all* the points on it.

Two other entertaining sections are those on the construction of regular polygons and on the various approximations to π. It is amazing that the author has made the statement, so often seen in print, that Gauss proved that the circle can be divided by rule and compass into n equal parts *only* when n is a prime of the form 2^m+1. Probably it is a slip of the pen in this case, for only seven pages earlier the division into fifteen parts is referred to. Nevertheless, the wrong statement is definitely made, and it really seems as hopeless to try to get this vulgar error corrected as to expect authors to spell the name Bernoulli properly. After all, the practical man, with tools that range from a sixpenny protractor to a dividing engine, cares not for these abstractions. How different it was a few centuries ago! not better, of course, but certainly more amusing. The "divine proportion" or "golden section" impressed the ignorant, nay even learned men like Kepler, with a sense of mystery, and set them a-dreaming all kinds of fantastic symbolism. Even to the Greeks it was *the* section; and their philosophers, doubtless infected by the East, speculated about atoms and regular solids in a way that seems to us childish, but was serious enough to them. At any rate, the man who first found out an exact construction for a regular pentagon had reason to feel proud of his exploit; and the superstitions which have gathered about the *pentagramma mirificum* are grotesque echoes of his fame.

Mathematicians now alive must sometimes feel it a rather mournful privilege to have read what is practically the last chapter in the chronicle of π. The first that is known at present is in the Rhind papyrus (2000–1700 B.C.), where the approximation $\pi=256/81=3\cdot1605$ is given; how it was obtained is, unfortunately, quite uncertain. Dr. Tropfke gives in detail Archimedes's very ingenious method, which he carried out far enough to prove that $3\frac{1}{7}>\pi>3\frac{10}{71}$. It is well known that 355/113 is a remarkably near approximation, which is easily remembered. It appears that this is due to a German mathematician, Valentinus Otho, who is said to have obtained it from $\frac{22}{7}$ (Archimedes) and $\frac{377}{120}$ (Ptolemy) by subtracting numerators and denominators. Shanks's calculation to 707 places of decimals still holds the record. The symbol π for the ratio of circumference to diameter is first used in William Jones's "Synopsis palmariorum matheseos" (1706); Euler made it popular.

Part iv. (pp. 141–186) is on logarithms. It gives a clear account of the methods of Bürgi and Napier, with specimens of their tables; of the later developments of logarithmic series; and of the most noteworthy logarithmic tables. By a curious irony of fate, the expeditious methods of calculation now familiar were not discovered until after the tables of Briggsian logarithms had been computed. The base of Bürgi's logarithms is nearly e, and that of Napier's nearly e^{-1}; but neither of them was acquainted with the true theory of natural logarithms, and "Napierian logarithms" is really a misnomer, when applied to natural logarithms.

Noticeable in the sections on plane and spherical trigonometry are the specimens of early tables, including Ptolemy's, and the account given of the treatise attributed to Nasir Eddin Tusi, of which a French translation was published at Constantinople in 1891. Dr. Tropfke describes this as the first systematic treatise on plane trigonometry, considered as an independent subject; moreover, it discusses oblique-angled triangles after the modern manner, instead of reducing the solution of them to that of right-angled triangles. This part of the book brings out the services rendered to mathematics in the middle ages by Arab, or more precisely Arabic-speaking, geometers. The inventors of the more important formulæ are also indicated. On p. 198 there is a note on Hero's *Μετρικά*, published so recently as last year; in this work occurs a term for the fourth power of a quantity, not previously known to have been used before the time of Diophantus.

As might be expected, the chapter on stereometry is mainly interesting for the account it gives of Archimedes's great discoveries. The brief section on analytical geometry shows how Fermat really invented the method independently of Descartes. Parent appears to have been the first to publish a treatise on analytical solid geometry; this was nearly seventy years after the appearance of Descartes's "Géométrie."

The only other important section of the book is that on conic sections. It cannot be considered so good as some of the others; it does not deal with projective properties at all, and thus does injustice even to Apollonius, to whom, rightly enough, a great part of the thirty-six pages is devoted.

To profit by this history no advanced knowledge of mathematics is necessary; and it is to be hoped that the author's labours will be rewarded by the appreciation of many readers.

G. B. M.

THE PRACTICAL METHODS OF FRACTIONAL DISTILLATION.

Fractional Distillation. By Prof. S. Young, F.R.S. Pp. xii+284. (London: Macmillan and Co., Ltd., 1903.) Price 8s. 6d.

IN his preface Prof. Young says that he wrote this book in the hope that the solution of the difficulties of fractional distillation might be rendered easier. He has written an eminently practical treatise on the subject and one that cannot fail to be of considerable value.

After an introductory chapter describing the necessary apparatus and the methods of carrying out a distillation process, the vapour pressures and boiling points of liquids are first dealt with. Very little is known of the connection between the vapour pressure and composition of a mixture of two or more perfectly miscible liquids. The simple formula for the vapour pressure of a mixture of two perfectly miscible liquids A and B,

$$P = \frac{mP_A + (100 - m)P_B}{100},$$

where P_A and P_B are the two partial pressures and m the molecular percentage of the compound A, is only strictly applicable when the two components are closely related in chemical composition, when they have the same critical pressures and when the attraction between the unlike molecules is equal to the geometric mean of the attractions between the like molecules. In certain other cases the deviations from the theoretical values are not large, but in the majority of cases the formula gives no approximation to the truth. Is it not possible that the deviations are due to the surface layer having a different composition from that of the bulk of the liquid, as is known to be the case with mixtures of certain alcohols and water?

In the chapter dealing with the boiling points of mixtures the cases of binary and ternary mixtures of minimum and of maximum boiling point are fully treated. There follows next an account of the constitution of the vapour and liquid phases, including the work of Brown, Lehfeldt and Carveth; Brown found that in certain cases with two components the ratio of the masses of the two in the vapour phase was equal to their ratio in the liquid phase multiplied by a constant, while Lehfeldt showed that the logarithms of the ratio in the vapour phase were a linear function of the logarithms of the ratio in the liquid. In another chapter the theoretical considerations worked out by Duhem, Margules and Zawidski are briefly given.

The next section deals with the methods of carrying out fractional distillations of simple and complex mixtures, and also with the various forms of still heads which have been devised at various times. This is undoubtedly the most valuable portion of the book, inasmuch as it is drawn almost entirely from Prof. Young's own work. The methods of fractional distillation are described in detail, great stress being rightly laid upon the graphical expression of results. This may be done most easily by weighing the distillate obtained at various temperatures and plotting the values of dW/dT thus obtained against the temperature; it is in this way only that the distillation of a complex mixture can be properly carried out, for components present in only small quantities may otherwise easily be overlooked. Many forms of still head are described, amongst which the most efficient have been designed by Prof. Young himself. Tables are given of the relative efficiency of the various designs, as shown by the results obtained with mixtures of benzene and toluene, and of other substances. A chapter follows here containing descriptions of the various forms of still heads used in manufacturing processes.

The remainder of the book deals in the main with the application of the methods previously described to certain problems, as, for example, the quantitative analysis of a mixture of liquids and the separation of the components of a constant boiling mixture. Amongst the latter examples occurs the interesting case of the removal of the last traces of water from alcohol by distillation after the addition of a small quantity of benzene. If the correct quantity of benzene has been added then there distils over the ternary benzene-alcohol-water mixture, leaving pure alcohol in the still. It is safer to add a slight excess of benzene, and in this case, after all the ternary mixture has come over, the remainder of the benzene distils as the binary benzene-alcohol mixture, leaving again the pure alcohol.

It is impossible to touch upon all the points of interest in this book. Its chief value lies in the fact that many examples are given of the various processes, mostly from Prof. Young's own work. Moreover, a considerable amount of hitherto unpublished matter is incorporated. Our thanks are due to the author for so useful a work.

E. C. C. B.

A FRENCH MANUAL OF FORESTRY.

Traité de Sylviculture. Exploitation et Aménagement des Bois. By Prof. P. Mouillefert. Pp. 476. (Paris: Félix Alcan, 1904.) Price 6 francs.

THIS is the second volume of a manual of forestry the first of which was noticed in NATURE of March 20, 1903. The present volume treats of the utilisation and management of woodlands, 361 pages being de-

voted to the former subject, 102 pages to the latter, and 14 pages to the table of contents, but there is no index. There are 106 plates representing the rates of increment in trees and woods, mature woods of different species, modes of pruning, destructive insects, methods of felling and transport.

The arrangement of the matter differs from that usual in other manuals of forestry; the account of the increment in trees and woods, which occupies the first 38 pages, being properly a part of forest mensuration, should come under forest management instead of under utilisation, and much of the latter subject as treated by Mouillefert is really sylviculture, and belongs, therefore, properly to vol. i. It is a pity that the French use the term sylviculture for the whole art of forestry instead of restricting the term, as we do, to the formation and tending of woods. The word "foresterie," which is sometimes used by French foresters, if employed in the same sense as "forestry" with us, would save much confusion of terms. The French also have no treatise on forest protection, which with us, as well as with the Germans under the title "Forstschutz," is a recognised branch of forestry, and hence in Mouillefert's book some account of damage by insects is given under the heading "exploitation," or forest utilisation.

Under the latter heading a full account is given of the methods of formation and tending of woods of the various species of trees, also of the utilisation of beech nuts for oil, of cork from *Quercus Suber*, of which a very complete account is given, of the cultivation of osiers, and of the production of truffles, to which 43 pages are devoted. It is therefore strange that scarcely anything is said about the production of resin and turpentine from the maritime pine, of which there are about a million acres in Gascony.

The production of poplar wood is largely followed by small landowners in France, and the wood of the grey poplar is preferred to all others, being said to be one quarter more valuable than that of the black or white poplars. Omitting the value of the land and considering only the cost of formation of a grove of poplar trees, Mouillefert states that they pay more than 12 per cent. on the capital expended, or that 80 trees per acre cost 3*l.* 10*s.* to plant, and yield 112*l.* at the end of thirty years, the hay grown under the trees paying for the cost of maintenance, including rates. The part of the book dealing with utilisation terminates with a short chapter on modes of felling and transport.

The last part of the book, on forest management, or the construction of forest working-plans, is short but effective, and includes nine cases of conversion from one system to another, and a chapter on usufruct in forests.

This book, as well as vol. i. of the series, contains some valuable information about French forests which is not included in the more professional treatises on French forestry, and we are promised two further volumes on the valuation of woodlands and on artificial plantations, so that the whole work when completed should prove valuable for reference.

W. R. Fisher.

OUR BOOK SHELF.

The School Arithmetic: being a School Course adapted from "The Tutorial Arithmetic." By W. P. Workman, M.A., B.Sc. Pp. viii+495. (London: W. B. Clive, University Tutorial Press, 1903.) Price 3*s.* 6*d.*

This useful volume is an excellent specimen of the work published by the University Tutorial Press. The treatment of the elementary rules calls for no special remark. The plan of explaining the nature of fractions and proving the rules applicable to them by exhibiting in parallel columns a particular arithmetical example and its generalised algebraic form is to be commended, inasmuch as by this means the student is impressed with the generality of the process and reasoning. The diagrammatic representation (p. 116) of the processes of multiplication and division of fractions appeals strongly to the understanding, and the teaching value of the book is much increased by the plan adopted by the author of cautioning the pupil against various errors into which he may be expected to fall. Contracted processes in the division and multiplication of decimals are adequately explained and illustrated. The interest of the schoolboy is secured in the chapter on averages by examples dealing with the cricket performances of the leading batsmen and bowlers of England, and with the various athletic "records" of the public schools.

Every branch of the subject is illustrated by a vast collection of examples. The treatment of compound interest proceeds without the use of logarithms, but to us it appears that an early introduction of the elements of logarithms into a school course is desirable, and that it would present no difficulty to an ordinary pupil. The use of a "log book" would greatly simplify calculations in questions relating to compound interest.

Free-hand Lettering; being a Treatise on Plain Lettering from the Practical Standpoint for Use in Engineering Schools and Colleges. By Victor T. Wilson, M.E. Pp. x+95; 23 full-page plates. (New York: John Wiley and Sons; London: Chapman and Hall, 1903.) Price 1 dollar.

This book is not a mere collection of copies which the student is to reproduce slavishly. The author states the object of the volume to be "to cultivate the conception that all lettering is design, that any mathematical or mechanical attempt at treatment is entirely impracticable in ordinary work." The information supplied and instructions given should enable the student to arrive at the end in view.

Junior Country Reader. III. Talks on Country Life. By H. B. M. Buchanan and R. R. C. Gregory. Pp. viii+198. (London: Macmillan and Co., Ltd., 1903.) Price 1*s.* 4*d.*

These simply expressed reading lessons should prove of great interest to young children in country schools. After reading what is here told him about the horse, cow, pig, and sheep, a boy should be able to give intelligent assistance in the care of these animals. The sections on rats and the weasel family, on ferrets, on animals met with in the woods, and on birds, should go a long way to develop a real appreciation of country life. The illustrations are numerous and good.

Green Mansions: a Romance of the Tropical Forest. By W. H. Hudson. Pp. 315. (London: Duckworth and Co., 1904.) Price 6*s.*

This story enables the author to show his familiarity with the vegetation, animal life, and climatic conditions of tropical South America. Incidents are subordinated throughout to descriptive writing, which, however, will interest many readers as much as the thread of romance running through the book.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

The Blondlot *n*-Rays.

SINCE the date of my last letter on this subject, published in your columns on January 21, I have made further numerous endeavours to confirm M. Blondlot's experiments.

It is by no means difficult to obtain some of the effects that M. Blondlot describes, but, so far as my observations go, these effects, when obtained, are in every case due simply to heat.

As mentioned by a previous correspondent, the luminosity of calcium sulphide is considerably affected by minute differences in temperature. For instance, a coin taken from one's pocket and held at the back of a calcium sulphide screen will, in a few seconds, show through the screen as a disc of increased luminosity, the effect being due to the warmth of the coin; or again, when two small calcium sulphide screens are placed upon two pieces of similar metal differing in temperature by only about 2° F., it is easy to discover which of the two pieces of metal is the warmer by the superior luminosity of the screen placed upon it.

This, I think, is the explanation of the experiment described in the advertisement columns of your issue of February 18, where it is stated that "if one of these screens be laid on the floor when it is very feebly fluorescing it will be invisible, but its light will increase when it is placed on the top of the foot and the muscles put into action."

I have repeated this experiment with home-made screens with entire success, my method being to use two screens each about 16 mm. by 2 mm. in size, of normally equal luminosity. When one is placed on the foot it brightens up considerably as compared with the other. This experiment is at first sight most convincing, but unfortunately for the *n*-ray theory I find no necessity for the presence of the foot at all. A boot newly taken off and still retaining some warmth, or any other warm object, acts equally well, while if one screen be placed on the foot and the other upon a can of water heated to the same temperature as the foot, no difference between the luminosity of the two screens can be detected. Again, the foot experiment does not succeed if a good thickness of paper or cardboard is placed between the foot and the screen so as to prevent the transference of warmth to the latter.

Prior to the date of my last letter, I had tried a similar experiment to that described by Mr. J. B. Burke in your issue of February 18. In my case a large calcium sulphide screen was exposed to a high power Nernst lamp, one half being shaded with lead and the other with several thicknesses of black paper, so that only half was exposed to the *n*-rays. Visually no difference could be detected in the brightness of the two halves of the screen, but on exposing a gelatino bromide photographic film in contact with the screen for some three minutes it was found on development that the portion of the photographic film that was in contact with the half of the screen that was shaded by the paper only was considerably more fogged than the other half. Here again, however, the result was clearly due to heat, the black paper being perceptibly warm to the touch, as when, in place of paper, a thin aluminium sheet was employed and the experiment repeated, no difference at all could be noted between the two halves of the developed photographic film.

Since making this experiment I have, when using two very small separate screens, one shaded only by very thin aluminium and the other by thick lead, succeeded in observing some slight excess in brightness in the former over the latter, but this has been discernible only when the aluminium had become appreciably warmed by the heat radiated from the lamp, so that the difference in temperature would, in the light of my other experiments, entirely account for the effect.

It is, indeed, very difficult altogether to eliminate the heat coming either from a Nernst lamp or an Auer burner except by using materials such as, for instance, water, which, according to M. Blondlot, is opaque to the *n*-rays. This in itself is instructive, as is also the point noted by M. Blondlot that the brightening of the screen under the influence of the *n*-rays is not instantaneous but is gradual, as also are most thermic effects.

During the past fortnight there have been published details of some new investigations made by M. Gutton and communicated by Prof. Poincaré to the French Academy of Sciences, according to which the luminosity of calcium sulphide screens is increased by their being placed in a non-uniform magnetic field. It is stated by M. Gutton that only a weak field is necessary, and that the effect is very sensitive.

Having spent considerable time in endeavouring to confirm this observation without the slightest success, it would interest me to know whether anyone else has tried it and with what result.

As everyone who has experimented on similar lines is aware, investigations of these descriptions are full of pitfalls, and it is very easy to see what one expects. For instance, if two or more faintly but equally luminous calcium sulphide screens of small dimensions, placed two or three inches apart, are observed, one will occasionally appear to become dim, and it is quite easy with a little practice, while looking directly at the screens, to make any one of them actually disappear at will, this being due to certain portions of the retina being much less sensitive to these weak radiations than other portions. However, one can scarcely suppose that a man of science of M. Blondlot's antecedents and experiences can have deceived himself or have been deceived by others in regard to the numerous positive results that he has obtained, and those who have unsuccessfully tried the experiments can only imagine that, assuming that the phenomena observed are really objective, they are only visible to certain individuals. Whether the persons who can or those who cannot see these effects have abnormal sight further investigations alone can show.

66 Victoria Street, London, S.W., February 23.

A. A. CAMPBELL SWINTON.

Chalk-stuff Gas.

IN his notice of my "Papers on Education," in taking exception to my nomenclature, Prof. Smithells has touched on a question of much importance to teachers. "Chalk gas seems unnecessary," he says, "even as a temporary name for carbon dioxide. Why not 'Fixed air,' which is both descriptive and historical?" A young student (about eighteen years old) who went through my course two or three years ago, who has read the article, writes to me unsolicited a letter on the subject, from which I may be allowed to quote the following passage:—"One remark struck me. The reviewer wants to know the advantage of calling CO_2 chalk-stuff-gas and suggests that the classic old 'Fixed air' would be better. He does not seem to appreciate that by calling the gas 'Fixed air' you must presuppose that it is fixed and hence all that the word 'Fixed' entails of a knowledge of the gas; whereas, your name is eminently descriptive and entails no knowledge of the gas at all but simply describes the source from which it was first obtained."

I could not state my case more happily. I regard the use of names which are obviously appropriate at the time when the work is done, which do not involve giving the case away, as of extreme importance. In these days we are somewhat spoilt by the use of names which are significant of composition if not of structure; we are too prone to introduce them without consideration when teaching beginners; it is often desirable to give names temporarily. It must not be forgotten that the Germans, even at the present day, openly speak of acid-stuff and water-stuff; we do likewise in using the names oxygen and hydrogen, although our devotion to classics leads us perhaps to disguise the fact. In teaching beginners I advisedly speak of the gas from chalk (or limestone) *stuff*, because chalk has a definite geological connotation: we deal only with the substance of which it chiefly consists.

HENRY E. ARMSTRONG.

IN alluding to the subject of names in the notice of Prof. Armstrong's book, my chief object was to deprecate the excessive violence of the objections which I have so often

heard in reference to his terminology. I agree with Prof. Armstrong that there is some advantage to be gained during early stages of instruction by using names that do not prejudge the chemistry of the problem that is being investigated. But I think history usually supplies a good provisional name, such as inflammable air, calx of lead, spirit of nitre, and personally I should keep to the historical name where possible.

To call carbon dioxide chalk-stuff gas asserts that it comes from chalk, or that, in other words, it is a kind of air fixed somehow in chalk. I confess I cannot see that any greater presupposition is involved in calling it fixed air than in calling it chalk-stuff gas. Historically it was called fixed air, and I value the name because Black's clear perception and proof that a gas could be fixed in a solid and be a weighable material part of it was the means of inspiring Lavoisier with the right view of the part played by air in the calcination of metals, and so led to results of revolutionary importance. ARTHUR SMITHELLS.

Variation in Oat Hybrids.

AMERICAN and English observers have shown that the principles enunciated by Mendel are applicable to hybrid wheats. From observations carried out at St. Andrews, I have been able to demonstrate that the same principles are applicable to hybrid oats.

In 1901 I crossed a few white varieties of oats one with the other, and also black varieties with white ones. The progeny was in all cases characterised by very great vigour and prolificness. The hybrid characters were most easily distinguishable in the crosses between black and white varieties, the unilateral ear and dark grain of the one parent, and the pyramidal ear and light-coloured grain of the other, being so blended in the respective hybrids as to result in a somewhat one-sided ear and rich brown grain. It should be mentioned that by the colour of the grain is meant that of the closely adherent flowering-glume.

The grains of the four hybrids given below, after being classed according to their position in the spikelets, were sown singly in rows of one hundred each. At harvesting the ears of each plant were tied together, and the product of each row made into a separate bundle.

Long continued wet weather had damaged the plants so seriously as to render the working out of certain points impossible, *e.g.* the variation in the ears. From what has been noted in the available examples studied, the form of the ear will no doubt be found to be a constant character in the Mendelian sense. Sufficient material has been secured to show the dissociation of the colour of the grain.

The numbers of plants bearing respectively black, brown, white or yellow grain in the several bundles varied considerably. The totals only are given in the subjoined tables, the brown being classed with the black grain, and the yellow with the white. The distinction between the two classes thus tabulated was in all cases so marked as to offer no difficulty in sorting out, and they are therefore briefly put as black and white.

Goldfinder ♀ × *Black Tartarian* ♂ (*two plants*).

	No. of grains sown	No. of plants saved at harvesting	No. with black grains	No. with white grains	Ratio of black and white
(1)	1000	567	433	134	3·23 : 1
(2)	900	566	415	151	2·75 : 1

Black Tartarian × *White Canadian* (*one plant*).

890	532	379	153	2·48 : 1

Black Tartarian × *Abundance* (*one plant*).

600	274	209	65	3·21 : 1

The Black Tartarian oat is thus shown, in respect of the character in question, to be dominant, whether serving as pollen or seed parent. It is impossible to say whether the destruction done by bad weather affected one type more than another. If all the plants had survived, the proportion of black to white forms shown in the above tables might have been somewhat altered, but for several reasons it may safely be assumed that, at most, the alteration would not have materially affected the conclusion so clearly pointed to, namely, that the dominant and recessive characters in hybrid oats, as in many other self-fertilised plants, assert themselves in the second generation in a ratio closely approximating 3 : 1. JOHN H. WILSON.

Agricultural Department, St. Andrews University.

Visitors from the High North in Central Italy.

THAT *vexata quaestio* the migration of birds presents strange anomalies which confound the best informed theories on the subject. Last winter we had a surprise in the appearance in central Italy of the great white-billed diver, *Colymbus adamsi*, G. R. Gray, two of which were captured, a big ♀ on the Lake Chiusi or Montepulciano on December 2, 1902, and a large-billed ♂ on the 19th of the same month on Lake Trasimeno. Both were adults in autumn plumage, and are now in the central collection of Italian vertebrata in this museum. It is the first time that this sub-polar and eastern species has been noted in Italy.

This winter we have had a considerable invasion of that beautiful northern bird, the waxwing (*Ampelis garrulus*, L.). During December and January last they appeared in hundreds in our northern provinces, and from Vicenza, Padova, and Verona spread in flocks westward and southward. I received the first specimens on December 18, 1903, from Vicenza, and the last from Barberino di Mugello (Florence) and from Fano (Marche) on January 1 and 15. I also heard from Nice that more than 200 specimens, said to have come from Corsica, had been sold in the market. HENRY H. GIGLIOLI.

R. Zool. Museum, Florence, February 22.

THE NEW BUILDINGS AT CAMBRIDGE.

THE King, accompanied by the Queen and Princess Victoria, visited Cambridge last Tuesday to open the new Law School and Science Laboratories which have recently been completed on the site the university acquired from Downing College a few years ago.

On reaching Cambridge, the royal party proceeded to the Senate House, where, in the absence of the Chancellor, the Duke of Devonshire, who was prevented from attending by illness, the Vice-Chancellor, Dr. Chase, president of Queens' College, presented an address, which was graciously replied to by his Majesty. In the course of his reply, the King remarked that he earnestly desired the well-being of the university and "the extension and development of all branches of study and research which are essential to the maintenance and the greatness and the welfare of my Empire." There must, he added, be "new endowments for education if my realm is to be kept up to its proper standard of efficiency." The Vice-Chancellor then gave a short description of the buildings, and an account of the Cambridge Association, whose benefactions had enabled the university to build them. He also dwelt upon the pressing need for buildings for the department of agriculture, and for proper provision for housing the ethnological and archæological collections of the university.

When the ceremony was over the King and Queen were entertained at lunch by the university in the large gallery at the Fitzwilliam Museum. The royal lunch party was strictly limited in number, and the university entertained a number of distinguished guests in the halls of Gonville and Caius and of King's College.

After the lunch the royal party inspected the new buildings, which comprise the Medical School, the Sedgwick Memorial Museum, the new Botany School, and the Squire Law Library and Law Lecture Rooms.

FIG. 1.—Botanical Laboratory: Elementary Class-room.

Of these the building for medicine lies on the north side of Downing Street and covers the site of the old Anatomical School so well known to the pupils of the late Sir George Humphry. The plans for this building were designed by Mr. E. S. Prior, of Gonville and Caius College, who has shown considerable ingenuity in satisfying the requirements of the several professors on a very awkwardly shaped site. The basement, which is partly beneath the level of the ground, is given over to store-rooms, workshops, combustion and photographic rooms, and engines and a ventilating installation on the Plenum system. On the ground floor are small laboratories connected with the medical and surgical departments and the chemical laboratories of Dr. Bradbury, the professor of pharmacology. Here also is a large lecture room capable of seating two hundred students, and the pathological museum. On the first floor is the spacious Humphrey Museum, the walls of which are lined with glazed tiles, and the library, which is fitted with movable book-cases which can readily be pulled out into the room. Near by is the private room of the professor of pathology, Dr. Sims Woodhead. On this floor also are rooms for Dr. Clifford Allbutt, the regius professor of medicine, and for Dr. Howard Marsh, the professor of surgery, and a class-room capable of holding fifty or sixty students. On the top floor are the spacious pathological laboratories, lighted from above; also rooms for the demonstrators and lecturers, one of which is specially adapted for hygiene, under the supervision of Dr. G. H. F. Nuttall.

In all the rooms the gas-pipes, water-pipes, and electric wires are carried in covered chases, and can be reached at a moment's notice. The walls and the ceiling are of adamant cement, and all grooves and corners are rounded. There are no angles, mouldings, or projections to catch the dust. It is proposed to supply the electricity used in the building by means of two Diesel oil-engines, and the new Medical Schools will be perhaps more self-contained than any other institution of the sort in Cambridge

Owing to lack of funds the syndicate entrusted with the erection of the medical schools has only been able to carry out two-thirds of the complete plan. In time it is hoped that the building will be connected with the eastern corner of the Physiological Laboratory, and that more rooms, which are earnestly needed, will be provided for the departments of physiological chemistry and pathology, and that a space will be set apart for a proper development and teaching of hygiene.

The Botanical School forms the southern side of the court, which the university is rapidly enclosing, on the site it bought from Downing College seven years ago. Externally the building is simple and without ornamentation, but its proportions are good and architecturally the effect produced is pleasing. The architect is Mr. W. C. Marshall, of Messrs. Marshall and Vickers.

FIG. 2.—Botanical Laboratory: Professor's Room.

The building is entered by two doors, from either of which access is gained to the large central lecture

room designed to accommodate some two hundred students. West of the lecture room is the herbarium, containing a very extensive collection of dried plants which have been accumulated since the chair of botany was founded in 1704, and a special library of systematic monographs. Corresponding with this, but on the eastern end, is a museum in which is exhibited a really remarkable collection of plants in spirit, besides many specimens of economic interest.

On the first floor of the building is a library, which contains more than four thousand volumes and in which nearly forty current scientific botanical periodicals can be seen. Above the herbarium is the morphological laboratory and the chemical laboratory with a photographic dark room.

The professor's rooms and rooms for sterilisers and incubators are over the museum, and other rooms on this floor are occupied by the lecturers in botany, Mr. Seward and Mr. Blackman.

On the second floor the western half of the space is occupied by a large laboratory capable of seating one hundred and fifty students. There are also rooms provided for the demonstrators and small lecture rooms for advanced students. The eastern end of this floor is occupied by a laboratory for plant physiology, connected with which is the dark room and the greenhouse. Mr. Francis Darwin, university reader in botany, has his rooms near by.

The large flat roof is well adapted for certain kinds of experimental work, and there are three greenhouses so arranged as to provide for the plants therein different external conditions throughout the year.

The great care exercised by Prof. Marshall Ward and the architect has resulted in the completion of what is probably the most complete botanical teaching institute in the Empire.

It is gratifying to know that the King's visit to Cambridge is being marked by the foundation of a scholarship of 100*l*. a year for encouragement of research in botany. The generous benefactor, who is already well known to Cambridge as the founder of a studentship at Caius College, is Mr. Frank Smart, of Tunbridge Wells.

Fig. 3.—Sedgwick Museum: West End.

In the year 1727 Dr. John Woodward bequeathed by his will to the University of Cambridge his collection of English fossils with the two cabinets containing them and their catalogues. From this small beginning the geological collections of the university have grown.

Fig. 4.—Humphrey Memorial Museum.

The magnificent pile of buildings which has recently been erected is partly a memorial to Adam Sedgwick, one of Cambridge's greatest professors, who died at the beginning of 1873 at the advanced age of eighty-eight. In the spring of that year a meeting was held at the Senate House at which it was decided to collect money to build a new geological museum in his memory. So large a sum was collected, and so long a time elapsed before the museum was begun that the trustees, a year or two ago, were able to hand over a sum of money which amounted, with the interest received during the interval, to more than 26,000*l*. The remainder of the cost of the building has been defrayed by the university.

The Sedgwick Memorial Museum was designed by Mr. T. G. Jackson, R.A. Its ground plan is of an "L" shape, one side running along Downing Street, where it adjoins the new Law Library, the other side, at a somewhat obtuse angle, forming the western boundary of Downing Place.

On the ground floor are numerous workshops, a very fine lecture room, and a museum of economic geology. On the first floor the Sedgwick Museum occupies almost the entire extent of the Museum, one corner of which is partitioned off, and

here Woodward's ancient cabinets are piously preserved. Adjacent to them are the rooms of the Woodwardian professor, Prof. Hughes, and a board room.

On the second floor are numerous students' class rooms and private rooms for the various demonstrators and teachers. On this floor also is a library the beautiful fittings of which were provided from a gift of money presented to the university by the late Master of Trinity Hall.

Between the two arcades, which lead from one wing of the Museum to the other, stands the bronze statue of Adam Sedgwick which was unveiled by the King on Tuesday. This statue was one of the last works of Mr. Onslow Ford, and represents the professor with a geological hammer in one hand and a specimen in the other. Considering that this statue was made more than thirty years after the death of him whom it commemorates it is wonderfully successful.

The Law School forms the central block on the north side of the new courtyard. It is, in fact, the centre of Mr. T. G. Jackson's façade. The university has been able to erect this noble building by the generous bequest of Miss Rebecca Flower Squire, who has also endowed certain scholarships to be held by law students in the university. To the 15,000*l.* which the trustees allotted for the purposes of the Law Library the university has been able to add sufficient to complete the Law School by the addition of professors' rooms, lecture rooms, and examination rooms. The main library is a lofty room 85 feet by 30 feet in area, lighted by spacious windows on the north and south, and with book-cases projecting towards the centre of the room between each window. Above these are ample space for storing duplicates and books which are seldom used. Each end of the room is provided with a handsome gallery.

For some time, owing to the wants of the university library, the professor of civil law has been driven out of the old Law School and has been a wanderer through the literary lecture rooms. Miss Squire's bequest has enabled the university to find him a home, and for the first time in the history of the Cambridge Law School, more than five or six hundred years, the students of law will assemble in a handsome and roomy building especially adapted for their very needs and in close contiguity to the ample library.

The illustrations which accompany this article are taken from photographs made by Mr. Palmer Clarke, of Cambridge.

EDUCATION AND PROGRESS IN JAPAN.

IN his address at Southport last September, the president of the British Association, taking as his subject "The Influence of Brain-power on History," traced convincingly and conclusively the intimate relation that exists between the provision made by a nation for the higher education of its people and the position taken by that nation in the ceaseless competition between the great countries of the world. After a searching comparison between the facilities for university education in this country on one hand and in the United States and in Germany on the other, Sir Norman Lockyer said:—"But even more wonderful than these examples is the 'intellectual effort' made by Japan, not after a war, but to prepare for one. The question is, Shall we wait for a disaster and then imitate Prussia and France; or shall we follow Japan and thoroughly prepare by 'intellectual effort' for the industrial struggle which lies before us?" It would indeed be difficult to find a more striking example of the profound and comparatively immediate effect on national prospects which an earnest and thorough attempt to establish a complete system of education can effect. The events of the past few weeks serve to bring into high relief what was before clear enough to students of educational progress, that Japan has succeeded in a little more than thirty years in bringing about a revolution without bloodshed, in changing an eastern people—among whom originality was considered a form of disloyalty—into a powerful nation equipped with western education and possessed of all the resources of modern civilisation.

In the following attempt to trace the leading events of these thirty years of Japanese progress in education, reference has been made to numerous authorities, but most of the facts included are from a statement of the development and present position of State education in Japan prepared by Mr. Robert E. Lewis, of Shanghai, and published in the reports of the United States Commissioner of Education.

The beginning of modern Japanese history dates from 1868. For three and a half centuries before this date, to quote Mr. Lewis, "Confucius was the headmaster of Japan, with Buddhist priests as his understudies." But with the coming of the new learning and with the arrival of English-speaking people from America in 1853 and from England—in the persons of Lord Elgin and his suite—in 1858, in which year the British-Japanese treaty was signed, a change commenced which was destined, as subsequent events have shown, to be a rapid one.

A provisional board of education was established in Kioto in 1868, and three years later the Mombu-sho, or department of education, was established with a Minister of State to preside over it. The first educational code was issued in 1872, and in promulgating it the Emperor said:—"All knowledge, from that necessary to prepare officers, farmers, mechanics, artisans, physicians, &c., for their respective vocations, is acquired by learning. It is intended that henceforth education shall be so diffused that there may not be a village with an ignorant family or a family with an ignorant member." In 1898, that is, in twenty-six years, out of 7,925,966 children of school age in the country, 4,062,418 were being educated in schools modelled on western plans. Moreover, if only the boys are taken into account, there were in that year 82.42 per cent. of the Japanese boys of school age receiving what may be described as education in the European sense.

In 1872 what was known as "the world's embassy," consisting of forty-nine representative Japanese, including Prince Iwakura and Marquis Ito, was at work, and much of its attention was devoted to observations of education in Europe and America. The plan of sending Japanese students to foreign countries for the purpose of studying modern thought and methods has been much employed by the educational authorities of Japan, though in recent years the custom has been largely discontinued, as highly educated Japanese have become available for university and similar posts. For instance, in 1873 there were 250 students studying in foreign countries at the expense of the Japanese Government, while in 1895 only eleven Japanese students were similarly officially sent abroad. The same tendency to dispense with foreign assistance at the first opportunity is noticeable also when the personnel of the staffs of the institutions in connection with the Japanese department of education is examined. Though in the years following the promulgation of the first education code by the Japanese Government the number of European and American professors and instructors was relatively

very large, by 1896 the total number of such foreign teachers in State institutions had fallen to thirty-one, of whom ten were from Great Britain and eleven from the United States. If, however, in addition to State institutions all other public and private educational establishments are included, it is found that the number of foreign instructors is much higher. Thus in 1895, 167 men and 101 women from Europe and America were engaged in teaching in Japan.

A complete understanding of the success of Japan's provision of university and technical education can only be arrived at by first considering the steps which have been taken in the direction of securing a satisfactory system of primary and secondary education. Japan seems to have learnt completely what is now only beginning to be understood in this country, that for complete success a system of higher education must be firmly based upon an adequate and properly coordinated supply of institutions in which a sound preliminary education is given. This seems to have been the idea in the mind of President Ibuka, who, speaking in America, said that when Japan reached out after western ideas she copied her navy from Great Britain and her educational system from America. It is therefore desirable to refer briefly to the conditions of elementary and secondary education in Japan.

The elementary schools of Japan are of two grades, ordinary and higher. It will be sufficient in this connection to refer to them as public elementary schools. In 1898 there were 26,322 of these schools, with an annual cost for maintenance of 1,715,470*l*., to which sum the Japanese taxpayer contributed 1,150,446*l*. Nearly five thousand of these elementary schools provide special supplementary courses of a more advanced character, in which preliminary instruction is provided for boys, in the branches of science underlying agricultural practice and rural economy, and those on which the needs of industry depend, while for girls the special requirements of the household are taken into account, and instruction is given in such subjects as sewing and needlework. It is interesting to notice that a decree of the Japanese Government dating from August, 1900, made the education in all public elementary schools to all intents and purposes free.

As indicating the attitude of the Japanese people towards education, it should be stated that their voluntary contributions towards its support are on a generous scale. In 1896 voluntary gifts to the public school fund amounted to almost 154,000*l*., in addition to which during a single year the people contributed for educational purposes 3,677,000 acres of land, 14,000 books, and nearly 16,000 pieces of apparatus. As Mr. Lewis has remarked, "it may be said roughly that in support of popular education in Japan the gifts of the people in money are more than one-fifth the amount realised from fees, and that the latter are about one-third as much as the amount of the local taxes for education." Before leaving the subject of elementary education, it is significant to remark that in 1896, while the percentage of the population of Great Britain under instruction in elementary schools was fifteen, Japan, with its short experience in educational matters, had managed to bring the percentage up to ten.

Intermediate between the public elementary school and the university, two classes of schools are to be found in Japan, the common middle schools and the high schools. As in some European countries, these schools are made more attractive to the Japanese people because attendance at them exempts from a certain amount of military service. Thus a common middle school course exempts from two or three years of military service, and attendance throughout a high school course excuses the student from conscription until twenty-eight years of age, when a single year as a volunteer with the colours exempts from further military service. The educational authorities of Japan have, too, learnt the importance of carefully coordinating one grade of school with those immediately below and above it. To give an instance, a pupil who has successfully completed the course of a common middle school can claim admittance to a high school without examination, and one who has obtained a certificate showing that he has attended the complete course of a high school may at once enter the university without a matriculation examination, and he is, moreover, considered to be fully qualified for any public post.

In 1898 there were in Japan 169 common middle schools, and in 1896 six high schools. In the former there were 2061 teachers and 49,684 students, and in the latter 290 teachers, of whom only twelve were foreigners, and 4231 students. Of the total number of students who completed the courses of the common middle schools, three-fifths entered high schools, one-eleventh entered the army, and one twenty-eighth became teachers. Of the high school students, 55 were in law courses, 127 in engineering, 1469 in medicine, and 2580 in general courses leading to the university.

It appears, says Mr. Lewis, that the subject most insisted on in the common middle schools is the English language; that the Japanese language and Chinese literature, studied as related themes, are second; gymnastics receives more attention than mathematics or history, and far more than ethics. The explanation of the anomaly is in the fact that by the training of the body Japan hopes to repair the physical defects of the people. The same authority states that the courses of study are not uniform in the Government high schools; in five of them the greatest emphasis is laid on the general preparatory courses for the university. One of them has departments of law and engineering, and its advanced courses constitute the beginning of Kioto University.

Though the foundation for technical education is laid in the elementary, middle and high schools of Japan, we may fairly say that the higher education of the country is given in its universities and technical institutions. It will be convenient to deal with the universities first.

There are two universities, one in Tokyo and the other in Kioto. The former is the more important, and it will suffice to indicate the nature of its work, constitution, and cost. The Imperial Tokyo University was organised in 1877, remodelled in 1886, and enlarged to include a college of agriculture in 1890. For the first ten years or so after its organisation the university followed the American plan, but since then it has been more inspired by German ideals. The university at present consists of a university hall—devoted to the purposes of post-graduate study including original scientific research—colleges for the study of law, science, engineering, medicine, agriculture and literature, library, botanical garden, astronomical observatory, marine laboratory, and two hospitals.

In 1898 there were 205 professors and 2465 students in the university. Though the distribution of these professors is not available for 1898, the 161 professors attached to the university in 1895 were divided among the six colleges as follows:—law, 22; medicine, 30; engineering, 35; literature, 25; science, 18; and agriculture, 31. The number of students has increased steadily year by year, as the following table shows:—

Number of Students in the Imperial Tokyo University.

College, &c.	1885	1890	1895	1896	1897
University Hall...	0	47	105	146	174
Law	217	301	472	551	737
Science	43	77	102	105	105
Engineering ...	30	106	295	345	385
Medicine	726	188	178	223	297
Literature ...	129	88	219	248	278
Agriculture ...	0	485	249	215	232
Total	1145	1292	1620	1833	2208

In 1898, 30 per cent. of the total number of students were studying law, 9 per cent. medicine, 31 per cent. engineering, 7 per cent. science, and 4 per cent. agriculture.

Mr. Lewis provides interesting particulars of the subsequent careers of the graduates from Tokyo University for the year 1896. Of 308 graduates that year 107 were given administrative or judicial positions by the Japanese Government, 48 were admitted to University Hall there to engage in original research, 45 obtained posts in banking houses and similar important commercial undertakings, 44 remained unoccupied, 42 became instructors in the universities and high schools, 15 remained in the colleges for post-graduate work, and 7 took up various other callings.

As regards the annual expenditure on Tokyo University, the following table shows the amounts spent on the different constituent colleges in the year 1895:—

Imperial Tokyo University Expenditure for the Year 1895.

	£
University Hall	11,000
College of Law	9,500
College of Science	14,000
College of Engineering	15,000
College of Medicine	52,000
College of Literature	11,000
College of Agriculture	15,500
Total	128,000

Now it must be remembered that the Government department of education is responsible for the maintenance of higher education in Japan, and it is at once seen that in Japan the State found for the Tokyo University in 1895, apart from the University of Kioto, about 130,000*l*. The present State contribution to the whole of our universities and colleges together amounts only to 155,600*l*., and in favoured Germany the State endowment of the University of Berlin in 1891–2 amounted to 168,780*l*., so that with educational traditions dating back only thirty-five years Japan is well on the way to an equal State expenditure on higher education.

The students of the Tokyo University are drawn, says Mr. Lewis, from all classes of society as in America. "There seems to be no special class of men who were predestinated for the university. . . . If the past thirty years might be taken as a basis, one may look forward to the time in Japan when, as in Scotland, the universities may claim one from every thousand of the population; or when, as in Scotland, one man out of each five hundred will have a *bona fide* university degree."

Besides the institutions of higher education which have now been described, there are in Japan, according to the Japanese Government report for 1896, sixty technical schools of various kinds. Thirty-seven of these are devoted to instruction in agriculture, seven to branches of industry, and sixteen to commerce. These sixty schools employ 424 teachers, and are attended by 7600 students. Among the more important of these schools the Tokyo Technical School takes a high place. It gives instruction in electrical mechanics, electrochemistry, dyeing, weaving, and many other branches of technology. The primary object of the school is to train manufacturing experts, and the school has already gained a high reputation for the amount of its original work for the improvement of manufacturing processes. Japan also has sixteen apprentice schools with 1875 students.

Merely to state the number of technical schools in the country is to fail to give a true idea of the Japanese system of technical education, because in both the elementary and secondary schools some attention is devoted to instruction of a technical kind. Though many authorities in this country, in Germany, and in America would disapprove of this approach to early specialisation, it seems probable that the great success of institutions like the Tokyo Technical School may be due to the fact that the early introduction of Japanese boys to technical studies makes it possible to weed out those unlikely to benefit by the advanced courses of the technical schools, and to concentrate attention on those who possess natural aptitudes for such work.

Such is a brief outline of the change which has taken place in Japan since 1868, when its first provisional board of education was formed. If with all the disadvantages under which she laboured Japan has been able by persistent effort and by continuous sacrifice in the way of State endowment and private munificence to effect an educational revolution, it requires little enough faith to believe that if as a nation we set to work to put our educational house in order—to endow adequately our present universities, to establish others where they are required, to level up our secondary education—there would be no need pessimistically to contemplate the future of the Empire, and to imagine for it a possible third or fourth place in the world struggle for supremacy. A. T. SIMMONS.

THE EVOLUTION OF MATTER AS REVEALED BY THE RADIO-ACTIVE ELEMENTS.

On Tuesday, February 23, Mr. F. Soddy delivered the Wilde lecture before the Manchester Literary and Philosophical Society. The lecture, it may be explained, is delivered annually, and is provided for out of an endowment by Dr. Henry Wilde, F.R.S.

After referring to the three-fold character of the rays emitted by radium, Mr. Soddy explained that the α-rays contained more than 99 per cent. of the whole energy given off, and were of paramount importance on other grounds, as opening up a new field of research with which the ordinary methods of chemical analysis had no connection. The mass of the particles composing the α rays was about equal to that of an atom of hydrogen; they carried a positive charge, and were deviable, though to a very minute extent, in a powerful magnetic field. Their velocity was about 20,000 miles a second, and they were easily stopped, even by a thin sheet of paper, or a few centimetres of air. All three kinds were detected by their power of exciting fluorescence in certain substances, and by their action on a photographic plate, but their distinctive property was that of ionising the air and other gases through which they pass. Had it not been that their energy effects are out of all proportion to the masses of the bodies concerned, the radio-active property would have remained undetected. Thus uranium and thorium have been known for several generations, yet it is no longer ago than 1896 that Becquerel began the researches which have since proved so fruitful in the hands of M. and Mdme. Curie, Prof. Rutherford, Sir W. Ramsay and others.

As regards the radio-active elements themselves, they are regarded as undergoing a slow spontaneous

change into other elements. The parent form disintegrates and throws off a portion of its substance, leaving a residue which undergoes a further change of a like explosive character, and so on, until a form of matter is reached in which no other change is possible. The explosion differs from that of a body like fulminate of mercury in that it does not gather strength with the mass of matter present, but is confined entirely to the individual atoms. All the effects observable in connection with radio-activity are referable to the α particles: thus fluorescence is excited in certain bodies by impact; the ionisation of a gas is brought about by the collision of these particles with the neutral molecules of the gas, whereby they are torn asunder into ions; the warmth of a mass of a radio-active substance is due to its being bombarded by its own α rays. As the process of disintegration continues, certain stages are reached in which the substances produced are of the nature of chemical elements, though differing from the ordinary conception of an element in that their existence is merely temporary. To these transition forms Prof. Rutherford and Mr. Soddy have applied the term "metabolons," and the duration of these is a specific property, depending on the nature of their aggregation. Thorium, for example, gives off an emanation which changes its character in so short a time as 87 seconds; the form of matter to which radium owes its power of exciting radio-activity in other bodies endures for about 43 minutes; that to which thorium owes a similar property lasts about 16 hours; the radium emanation for 5 days 8 hours; the uninvestigated next product of the disintegration of thorium, called thorium X, has a life of 5 days 19 hours; uranium X of about 4 weeks; polonium of 16 months; radium of 1300 years; uranium and thorium of about 10^9 years.

The atoms of ordinary chemistry represent the forms with longest life, and they exist to-day because they have survived a process of evolution in which those physically unfit have disappeared. The transition forms represent the elementary forms of matter unfitted to survive, but they are brought within our powers of knowledge because they constitute the temporary halting places through which matter is passing in a scheme of slow continuous evolution from the heavier to the lighter forms. During the whole existence of the metabolon, whether long or short, it behaves like an ordinary atom. No indication whatever seems to be given of its approaching end, but suddenly, by some internal cataclysm, the cause of which is at present almost beyond conjecture, it flies to pieces and ceases to exist in the form previously assumed. A new world is thus opened out in which the atom is not the unit, in which the forces are not chemical, and in which common physical conceptions such as temperature are without meaning.

The operation of separating the transition forms from the parent element by chemical means does not in any way affect the progress of disintegration. Left to itself, the parent element steadily accumulates a fresh crop of the transition forms separated, while the quantities originally separated disappear as such by further change. As the activity of the parent element recovers to its maximum or equilibrium value, that of the transition forms decays to zero, and the sum total is always the same as if the separation had not been effected. On this view the products of disintegration must have been steadily accumulating through past ages, and the discovery of helium by Sir W. Ramsay in 1895 was the first definite proof that such was really the case. Helium is only known in association with the radio-active elements, and its inert character is one of the reasons for supposing that it is a final product of disintegration. Sir W. Ramsay and Mr. Soddy, during last summer, examined radium with the view of discovering whether or not it resolved itself into helium, and after weeks of waiting were able to establish that this is really the case. A very minute bubble was all that could be obtained, and its slow disappearance, probably by absorption into the glass, was not unexpected. Indeed, glass which has been subjected to bombardment by the α rays, when powdered and heated, has been shown to give off helium, so that the supposition is confirmed. All kinds of glass, however, do not behave in the same manner, the absorption in some cases being much more rapid than in others.

Viewed in relation to their length of life, it seems probable that radium, actinium, and polonium are merely slow-changing transition forms produced in the disintegration of the parent element uranium. Since the activity of polonium decays to half value in about a year, it follows that its existence in pitchblende at the present time is due to its continuous production in the mineral. Applying the same argument to radium, it must also be in a state of equilibrium, the amount produced in any given time being balanced by its rate of decay to inferior forms in that time. The lecturer had endeavoured to discover whether a quantity of uranium, originally free from radium, would grow a crop of that element, but a lengthy period must elapse before a definite conclusion can be reached. There is also an unknown factor in these considerations, viz. actinium, and until this element has been further investigated even speculation must be withheld. Pushing the matter back to its limits, we are face to face with the question, How and when did the universe originate? According to orthodox notions, it is tending to a state of exhaustion in which all change must cease. If, however, a constructive influence is at work, opposing this process, the whole system may turn out to be a conservative one, limited with respect neither to the future nor to the past, but proceeding through continuous cycles of evolution. This would be possible if a gradual and continuous accretion of atomic mass could take place, such as that by which the stable elements were originally formed. At present, however, all such views belong to the realm of pure conjecture.

LIEUT.-GENERAL C. A. McMAHON, F.R.S.

Charles Alexander McMahon, son of Captain Alexander McMahon, of the East India Co.'s Service, belonged to an old Irish family, and was born near Highgate on March 23, 1830. Educated as a soldier, he went to India in 1847 as Lieutenant in the Madras Native Infantry, and served for eight years in the 39th Regiment. In 1856 he was appointed a Commissioner in the Punjab, and was engaged for thirty years in various districts, including Lahore.

While politics and educational questions occupied much of his time, he became greatly interested in geology, and especially in the crystalline rocks and glacial phenomena of the western Himalayas. In his earlier work he was impressed with the intrusive character of the central gneiss of the great mountain range, and his enthusiasm was so aroused that he took the opportunity, while on furlough in 1879–80, of attending the courses at the Royal School of Mines, so as to be initiated in the latest methods of petrological research. Returning to India he worked with renewed zeal at the igneous and metamorphic rocks, and the results of his observations were mostly published in the records of the Geological Survey of India.

In 1885 he retired from service with the rank of colonel, and settled in London. He had been elected a fellow of the Geological Society in 1878, and he now took an active part in the work of the society, serving

on the council in 1888 and in subsequent years, and for a time as vice-president.

His attention was in 1887 attracted to the geology of the Lizard, and there his observations led him to maintain the igneous origin of many of the foliated crystalline rocks. He dealt also with the granite of Dartmoor, and showed that it presented the ordinary features of an intrusive igneous rock.

In 1894 he was elected president of the Geologists' Association for the usual two years, and in his addresses he summarised the results of some of his Indian work. He sought to dispel the popular notion that the Himalayas were upraised in late Tertiary times—they had, of course, a pre-Tertiary history, although there was a general absence of crushing and contortion prior to the Miocene, and these disturbances were due to the intrusion of the gneissose granite.

General McMahon was elected a fellow of the Royal Society in 1898, and in the following year the Lyell medal was awarded to him by the Geological Society. The president (Mr. Whitaker), in addressing him on that occasion, remarked, "Labouring under the disadvantage of taking to the study of geology comparatively late in life, you have attacked it with the energy of a British soldier, and have fought your way into the foremost rank of our petrologists."

In 1902 he contributed to the *Geological Magazine* (with Mr. Hudleston) an important paper on the fossils from the Hindu Khoosh. In the autumn of the same year he took duty as president of Section C of the British Association at Belfast. Since that date his health had gradually declined, and he died from heart failure on February 21. Personally he was endeared to all who knew him by his sterling character and by his genial and courteous nature. H. B. W.

THE NEW EDUCATION AUTHORITY FOR LONDON.

WE have received the following memorial referring to the proposed constitution of the Education Committee for London. An article upon the scheme adopted by the London County Council appeared in our issue of February 11.

To the Secretary of the Board of Education.

February 22, 1904.

Sir,

Having carefully considered the scheme proposed by the London County Council for the constitution of its Education Committee, which has been submitted for the approval of your Board, we, without bias towards any political party, desire to draw the attention of your Board to certain defects in the scheme which must seriously impair the efficiency of the committee in its work of coordinating and developing all varieties of education in London.

The Education Committee will have to undertake not only the work of elementary instruction hitherto carried out by the School Board, but it will also have the more difficult task of supplying and aiding the supply of secondary, technical, and higher education, and of promoting the coordination of all forms of education in London. The present backward educational position of this country is especially marked in those branches designated "secondary" and "higher." To develop the resources of London in these respects, to raise the standard of secondary education, to provide for the training of teachers for both primary and secondary schools, to organise and support the facilities for university training, and finally to organise a great technical high school in the university and the more strictly technical instruction of the polytechnics, so that the whole may be one educational edifice crowned by the University of London, will be a task of great magnitude, and will require the assistance of persons specially skilled in and acquainted with the needs and conditions of these various grades of education.

Under the scheme sent in by the County Council, it seems to us that no guarantee is afforded that the Council will have at its disposal any sufficient number of persons of experience in education and acquainted with the needs of the various kinds of schools in London. We would therefore urge on the Board of Education the desirability of amending the scheme so that the Education Committee may include persons who would be universally recognised as authorities on the needs of the university, the technical institutes, and the elementary and secondary schools.

While trusting that the Board of Education will take all possible means to secure the improvement of the scheme along the lines indicated above, we would earnestly deprecate any action of the Board that would lead to the postponement of the appointed day, on which, by the provisions of the Education Act, the administration of a unified system of education for London is to begin.

We have the honour to remain, Sir,

Your obedient Servants,

(Signed),

List of Signatures.

Dr. W. H. Allchin, senior physician to the Westminster Hospital, member of the Senate of the University of London; Dr. Henry E. Armstrong, F.R.S., professor of chemistry, Central Institute of City and Guilds; Right Hon. Lord Avebury, F.R.S., president of the Associated Chambers of Commerce; Sir J. Wolfe Barry, chairman of Executive Committee, City and Guilds Institute; Dr. Horace T. Brown, F.R.S.; Sir Lauder Brunton, F.R.S.; Dr. Henry T. Butlin, Dean of the Faculty of Medicine of the University of London; Prof. D. S. Capper, professor of mechanical engineering, King's College; Sir William Crookes, F.R.S.; Prof. Hugh L. Callendar, professor of physics, Royal College of Science; Mr. R. F. Charles, chairman of the Central Branch of the Teachers' Guild; Sir W. S. Church, Bart., president of the Royal College of Physicians; Prof. J. D. Cormack, professor of mechanical engineering, University College; Prof. G. Carey Foster, F.R.S., principal of University College, London; Mr. J. Easterbrook, headmaster of Owen's School, Islington; Prof. Ernest A. Gardner, professor of archæology, University College; Mr. Herbert B. Garrod, General Secretary of the Teachers' Guild; Sir William R. Gowers, F.R.S.; Prof. W. D. Halliburton, F.R.S., professor of physiology, King's College; Prof. M. J. M. Hill, F.R.S., professor of mathematics, University College, London; Rev. Arthur C. Headlam, principal of King's College, London; Sir Henry G. Howse, member of Senate of London University; Prof. W. P. Ker, professor of English, University College; Dean of the Faculty of Arts, University of London; Sir Norman Lockyer, K.C.B., F.R.S., president of the British Association; Sir Philip Magnus, fellow and member of Senate of University of London; Dr. Charles J. Martin, F.R.S., director of the Lister Institute of Preventive Medicine; Rev. J. Arbuthnot Nairn, headmaster of the Merchant Taylor's School; Prof. Karl Pearson, F.R.S., professor of applied mathematics, University College; Sir E. C. Perry, member of Senate, London University; Prof. John Perry, F.R.S., professor of mathematics, Royal College of Science; Sir William Ramsay, K.C.B., F.R.S., professor of chemistry, University College, London, president of the Society of Chemical Industry; Sir Owen Roberts; Dr. R. P. Scott, Incorporated Association of Head Masters; Mrs. S. T. D. Shaw, late lecturer at Newnham College, and at the Training College for Secondary Teachers; Dr. H. J. Spencer, headmaster of University College School; Prof. E. H. Starling, F.R.S., professor of physiology, University College; Miss L. M. Strong, head mistress of Baker Street High School for Girls; Dr. T. E. Thorpe, C.B., F.R.S., director of Government Laboratories, London; Prof. William A. Tilden, F.R.S., Dean of the Faculty of Science, University of London, president of the Chemical Society; Prof. Fred. T. Trouton, F.R.S., professor of physics, University College; Dr. John Tweedy, president of the Royal College of Surgeons; Dr. A. D. Waller, F.R.S., director of the physiological laboratory, University of London; Sir W. H. White, K.C.B., F.R.S., president of the Institution of Civil Engineers; Sir H. T. Wood, secretary, Society of Arts; Mrs. E. Woodhouse, head mistress of the Clapham High School.

NOTES.

THE instructive article on Japanese education, in another part of this issue, serves admirably to show the importance of education, especially higher education, as the chief factor of national progress. In a period shorter than that which has elapsed since the passing of our Elementary Education Act in 1870, Japan has introduced and perfected a properly coordinated system of education extending from the primary school to the university. More than this, Japan has put into practice the policy which has always been urged in these columns, that higher education is a State charge which ought not to depend upon private benefaction for its endowment. Reversing the order of this country, the universities of Japan rely financially upon the national exchequer, while the elementary schools, though assisted by the State, are considered primarily a local charge. The national bureau of education has no responsibility for the support of elementary or secondary schools, which derive the greater part of their funds directly from local sources. The department is, however, responsible for all higher education. As an object lesson of the profound influence which universities can exert upon a nation's development Japan's rapid advancement is perhaps unique, and it is to be hoped that the same enlightened views which have during the past thirty years dominated the rulers of that country may soon direct the educational policy of British statesmen.

IN connection with the King's visit to Cambridge to open the new buildings, a descriptive account of which is given in another part of this issue, the *Times* has published a series of three articles entitled "The New Buildings at Cambridge." The first article details the steps taken to put into practice the recommendations contained in a letter—accompanied by a detailed statement concerning the financial condition and requirements of the university—from the Duke of Devonshire, the Chancellor of the university, to the *Times* in 1897. The second article describes the buildings already provided at Cambridge, and the third institutes a comparison between what has been accomplished by the Cambridge University Association, fostered by the Chancellor, and what there is yet to be done so that Cambridge may be fully equipped in the modern sense. We are glad to notice in the concluding article of the series that the special correspondent to the *Times* follows the lead given by the president of the British Association in his Southport address, and quotes the comparison made by him between what our Government does for higher education and the amount of the State aid for universities in Germany and in the United States. The article is strengthened further by several of the quotations which Sir Norman Lockyer made from public speeches of leading British statesmen showing that they were learning to appreciate the intimate connection between the supply of higher education and national prosperity.

THE Paris correspondent of the *Daily Chronicle* announces the death of M. Henry Perrotin, the eminent French astronomer, and director of the Nice Observatory, at the age of fifty-eight.

AT a meeting of the Bath Town Council on Tuesday the Mayor announced that, as the result of further investigations, the Hon. R. J. Strutt has come to the definite conclusion that there are traces of radium in the Bath mineral water.

AS announced last week, a Bill for rendering compulsory the use of the metric system of weights and measures was read a second time in the House of Lords on February 23. In connection with this subject the historical documents brought together in a contribution which appears elsewhere in this number are of great interest. From these records it appears that toward the end of the eighteenth century a decree of the French National Assembly suggesting the universal adoption of natural units of weights and measures was communicated to our Government. In the year 1790 the confused condition of our weights and measures was brought before the House of Commons, and decimal standards were suggested. A committee was appointed to consider the matter, and the action taken by the House of Commons was one of the reasons urged in favour of the proposition which led ultimately to the adoption of metric weights and measures by France.

IN the course of the debate in the House of Lords last week on the Metric Weights and Measures Bill, Lord Kelvin gave an amusing illustration of the confusion arising from the use of different systems of weights, for in some experiments with a rifle he had put in a charge which might have caused a disastrous accident if the mistake had not been found out in time. The Marquess of Lansdowne also gave an instance of the confusion arising from the use of different weights in this country and on the Continent. A friend of his travelling abroad sent an English prescription to a local practitioner and received a box of pills of the size of small marbles, which, however, he did not take. The chemist came and said that his assistant did not know the difference between a grain and a drachm, and had put 30 grains of calomel into each pill. The illustrations given by Lord Kelvin and the Marquess of Lansdowne of the misadventures that may arise from the simultaneous use of two different systems of weights and measures show the advisability of there being only one international system.

A CIRCULAR was sent from the Colonial Office to the Colonial Governors in December, 1902, asking what action was likely to be taken in their respective colonies with regard to the resolution adopted at the conference of Colonial Premiers in London in favour of the adoption of a metric system of weights and measures. The replies received have now been published in a Parliamentary paper (Cd. 1940), and are thus summarised. The metric system is already used in Mauritius and Seychelles. The following are favourable to its adoption:—Australia, New Zealand, Cape of Good Hope, Transvaal, Orange River Colony, Southern Rhodesia, Gambia, Northern Nigeria, Gibraltar, British Guiana, Trinidad, Leeward Islands, Windward Islands. Also, with a reservation that it must also be adopted in the United Kingdom or in the Empire generally, Sierra Leone, Southern Nigeria, Ceylon, and Falklands. Hong Kong would take common action with other colonies. The States of New South Wales, Victoria, and Western Australia are also favourable, but, together with South Australia and Tasmania, consider that the matter is one for the Commonwealth Government. Fiji is doubtful, but must follow Australia and New Zealand. British New Guinea would go with Australia. Jamaica and British Honduras need the adoption of the system in the United States of America. The practice of India is important to the Straits Settlements, which would be followed by Labuan; and the Bechuanaland Protectorate would follow the rest of South Africa. St. Helena, Cyprus, Lagos, Wei-hai-wei, Barbados, and Bahamas are on the whole unfavourable. The Gold Coast Colony and the State of Queensland are prepared to adopt, but consider that inconvenience would occur. Natal cannot consider the matter until some general lines of legislation have been agreed

upon by His Majesty's Government. No definite answer has been given by Newfoundland, Malta, or Bermuda. Canada has not yet replied.

THE Smithsonian Institution has commenced the publication of a quarterly issue of its "Miscellaneous Collections," "designed chiefly to afford a medium for the early publication of the results of researches conducted by the Smithsonian Institution and its bureaus, and especially for the publication of reports of a preliminary nature." The first number of the quarterly issue is a double one, and contains seventeen articles, ranging in size from one page to seventy-three pages, in addition to interesting and timely notes on the activities of the institution, its collections, &c., the whole accompanied with fifty-six plates and numerous text figures. The scope of the journal is broad, the first issue embodying articles on mammalogy, astrophysics, palæontology, archæology, geology, ornithology, ichthyology, ethnology, &c., thus covering a considerable range of scientific subjects.

PROF. GUIDO CORA writes:—"A slight earthquake occurred in Rome on February 24 at 4h. 53m. 30s.; the amplitude of the undulations registered was between 4 and 5 centimetres; the earthquake lasted ten seconds. Observing it on the hilly part of the town, in the north-west, I noted three slight shocks of undulatory and horizontal character, about west to east in direction. The centre of the earthquake is not yet known, but is supposed to lie in the Sabina, owing to the fact that a more important shock took place on the same day in Magliano dei Marsi, near Avezzano, about 70 km. east-north-east from Rome. A small seismic disturbance was also observed in Rome on February 20."

GREAT damage was done at Magliano dei Marsi on February 24 in consequence of the earthquake shock. In the village of Rosciolo also, buildings were seriously damaged. Fresh earthquake shocks were felt on the morning of February 25 in the neighbourhood of Avezzano, and also at Rocca di Papa and Velletri.

THE *British Medical Journal* states that Prof. Chantemesse has been appointed to the post of general inspector of the Sanitary Service in France, vacant by the death of Prof. Proust, which occurred during the sittings of the International Sanitary Conference in Paris last autumn. The chair of hygiene, also rendered vacant by the death of Prof. Proust, has also been given to Prof. Chantemesse.

WE learn from *Science* that Sir Norman Lockyer's address at the Southport meeting of the British Association, on "The Influence of Brain-power on History," has been reprinted from *Littell's Living Age* by the New England Education League and International Education Conference. Copies may be obtained in large or small quantities at the rate of two cents each (postage extra) from Mr. W. Scott, secretary, 40 Dover Street, West Somerville Station, Boston, Mass., U.S.A.

IT is announced by the *Times* that at the last meeting of the committee of organisation of the International Congress on Tuberculosis in Paris it was decided to postpone for one year the opening of the congress, which had been fixed for the month of October. The congress will take place in Paris, October 2–7, 1905, in the Grand Palais (Section de l'Avenue d'Antin). This decision was taken in consideration of the International Exposition at St. Louis, and in consideration of the International Tuberculosis Congress, which will meet at St. Louis from October 3–5, 1904.

THE following are the prize awards of the Reale Istituto Lombardo for the current session:—Cagnola prizes, for the cure of pellagra; two premiums, one to Dr. Carlo Ceni, of Reggio, Emilia, and one to Drs. Giuseppe Antonini, of Voghera, and Angelo Mariani, of Bergamo; the essay of Dr. Giuseppe Manzini, of Udine, receives honourable mention. For the steering of balloons two premiums have been awarded, the essays dealing in either instance with determinations of air resistances. One premium is given to the engineer Cosimo Canovetti, and the other to Dr. Giorgio Finzi and Dr. Nicola Soldati. For a monographical study of hypophysis, a premium has been conferred on an anonymous competitor. Fossati prize, on the so-called nuclei of origin or termination of the cranial nerves, a premium to Dr. Giuseppe Tricorni-Allegra, of Messina. For the Brambilla industrial prize there has been, as on previous recent occasions, keen competition amongst the Lombardy manufacturers. First prizes are awarded to Baletti and Co. for silk gauzes, and to Lombardi and Macchi for pickles and preserves. Second prizes are awarded to Luigi Spadaccini for wire ropes; Redaelli, Finzi-Perrier and Co. for velvet and plush; Macchi and Passoni for implements for metal work; L. Sconfietti, engineer, for apparatus for producing a moist atmosphere in textile works; and Tommaso Giussani, of Milan, for wood preservation.

THE prizes offered by the Reale Istituto Lombardo for future competition are as follows:—The institution prize for April, 1904, will be given for an essay on the work of Vittorio Alfièri; for 1905 on the so-called "ophiolitic" deposits (of Savi) of the northern Apennines. The triennial medals for industrial and agricultural improvements in Lombardy will next be awarded in 1906. The subjects for the Cagnola prizes on themes proposed by the institution are:—for April, 1904, velocity of kathode rays; for 1905, phenomena of catalysis. The subjects designated by the founder for the other prizes are cure of pellagra, nature of miasma, steering of airships, and prevention of forgery. The Brambilla prize is offered for improvements in the Lombardy industries. The subjects for the Fossati prize are:—for 1904, localisation of cerebral centres; for 1905, neurology; and for 1906, visual centres of higher vertebrates. For the Kramer prize the subject is resistances of structures in cement; for the Secco Comneno prize, the virus of rabies; for the Pizzamiglio prize, influence of socialism on private rights; for the Ciani prizes, popular Italian books; for the Zanetti prize, improvements in pharmaceutical chemistry; and for the Tommasoni prize, the life and works of Leonardo da Vinci.

IN a recent note attention was directed to the conjectured discovery of a new species of Androsace in the Valle Anzasca (Macugnana). From a note contributed by Prof. Ardissone to a later issue of the Lombardy *Rendiconti* it would now appear that the plant in question does not even belong to the same natural order as Androsace, but is a species of Saxifraga, approaching fairly closely to *S. excavata*. We are thus reminded of a somewhat similar mistake which occurred in our own country when the stunted form of *Campanula glomerata* peculiar to short grass pastures was mistaken for a gentian.

THE Engineering Standards Committee has issued a statement of work now in progress. The committee commenced operations in April, 1901, and to it falls the duty of organising the work, considering what subjects shall be dealt with, appointing the chairmen of the various committees,

passing the reports of the committees before they are published, controlling the expenditure, and devising the means of raising the necessary funds to carry on the work. This main committee has appointed twelve sectional committees, and under these again are eighteen subcommittees. The first report issued was that on standard rolled sections for constructional work, and the standard sections are now finding their way into use throughout the Government departments as well as the general trade of the country. Another committee has been engaged in drawing up a standard specification for steel used in the hulls of ships, and a small subcommittee is drafting a specification for boiler steel. The locomotive committee has drawn up and forwarded to the Secretary of State for India a report on the subject of standard types of locomotives for India. The subcommittee on tramway rails has published a series of standard sections and accompanying specification. Subcommittees on telegraphs and telephones and on cables have drafted respectively a standard specification for wires used in the construction of telegraphs and telephones, and standard lists of sizes of cables, &c. The secretary of the committee is Mr. Leslie S. Robertson, 28 Victoria Street, Westminster, S.W.

At a general meeting of the fellows of the British Academy held on February 24, Prof. T. W. Rhys Davids read a paper on "Oriental Studies in England and Abroad," in which he made an interesting comparison between the facilities for higher teaching in Oriental subjects in this and in other countries. In the University of London there is an imposing array of names, but only one salary. At the old universities there are professors of Arabic whose stipends are nominal. There is the Boden professorship at Oxford, and at Cambridge Sanskrit is endowed out of college or university funds. Small grants are made at Oxford for Assyriology, for Semitic teaching at Dublin, and for Chinese at the older universities. Advanced work in Persian is done at Cambridge, and to the list may be added a few readers in Indian law. Compare this with what is done in some Continental countries. Holland has eight fully paid chairs and eight readerships. Germany has fifty-one professors and fifty readers or teachers of lower grade. In Berlin the Oriental Seminar enjoys endowments of 8000*l.* a year, and is attended by 162 university students and 66 other hearers. None of these pay fees. In France there are fourteen professors, five assistant professors, and five native teachers, a library of 35,000 volumes, and a valuable collection of MSS. In St. Petersburg Oriental learning is more recognised than perhaps anywhere else.

The Yorkshire Naturalists' Union is to be congratulated on the energy displayed by its members in collecting funguses. As the result of this, the January number of the *Naturalist* contains notices of no less than seventeen species not previously recorded from Britain, nine of these being regarded as new to science. The paper is illustrated with an excellent coloured plate, in which some of the more striking forms are depicted.

Hollows in the stems of oak-trees would apparently be the least likely places in which to find salamanders; nevertheless, such situations are the haunt of the Californian *Autodax lugubris*. According to Prof. W. E. Ritter, in the *American Naturalist* for 1903, workmen employed in clearing oaks in the grounds of the California University took numbers of both the salamanders and their egg-clusters from chinks and holes in the bark of these trees.

Two other articles in the *American Naturalist* demand brief mention. In one Mr. H. W. Shimer continues the series devoted to the description of the adaptations of mammals to special modes of life, dealing in this instance with fossorial forms. In the other Prof. W. Patten returns to his favourite theory as to the arthropod affinities of the fish-like Pteraspis and Cephalaspis of the Old Red Sandstone. The subject is rediscussed in considerable detail, the author dismissing the theory that the resemblance between the two groups is due to mimicry or parallelism as unworthy of credence, and reiterating his arguments in favour of their genetic affinity. Much importance is attached to the "fringing lateral plates" of Cephalaspis as indicative of arthropod relationship.

The habits and life-history of the holothurian *Stichopus japonicus* form the subject of an article by Dr. K. Mitsukuri in the first part of vol. v. of *Annotationes Zoologicae Japonenses*. As this creature forms a marketable commodity, the author discusses the possibility of increasing the supply by cultivation and protection; its roving habits are, however, a bar to dividing up the shore into lots for separate leasing, after the fashion followed in the case of oyster-beds.

A second edition of the "Index Bryologicus," compiled by M. E. G. Paris, is being published by A. Hermann, of Paris; all mosses will be included which were recorded before the year 1901. The work will consist of twenty-four or twenty-five parts, which will be brought out monthly at $2\frac{1}{2}$ francs the part. The editor requests the collaboration of bryologists to send him information with regard to corrections or omissions, which will be collected into an appendix.

The pioneer work which has been carried out by the British Cotton-Growing Association in introducing cotton cultivation into our colonial possessions is already beginning to show results, and now that the Colonial Office has promised to render its valuable assistance, the success of the scheme seems to be practically ensured. It is significant to find that during the last few weeks samples of cotton grown at Ibadan from American seed have arrived from Lagos which compare favourably with the ordinary upland American cotton. In the West Indies the Sea Island variety has been sown, and it is expected that during this year 20,000 acres will be under cultivation. Samples received from this source have been valued at prices ranging from 1*s.* to 1*s.* 4*d.* per lb. It is intended to introduce cotton into British East Africa and Rhodesia, and samples have already been received from British Central Africa.

By arrangement with Messrs. Smith, Elder and Co., Messrs. Watts and Co. have issued for the Rationalist Press Association, Ltd., at sixpence, "An Agnostic's Apology," by the late Sir Leslie Stephen, K.C.B.

We have received the issue for the present year of the "Annuaire de l'Académie Royale des Sciences, des Lettres et des Beaux-Arts de Belgique." In addition to the usual lists of members and committees, the volume contains biographical notices of MM. C. de la Vallée-Poussin and P. Benoit, and a historical account of the Royal Academy by M. le Chev. Edm. Marchal.

The twenty-fourth annual report of the Wellington College Natural Science Society affords interesting evidence of the good work which such associations can accomplish in connection with public schools. The sectional reports

include an exhaustive meteorological record for each day of 1903, and particulars of the field work in which the members of the society engaged during the session under review.

THE first two volumes of Mr. Herbert Paul's "History of Modern England"—which is to be completed in five volumes—have been published by Messrs. Macmillan and Co., Ltd., at 8s. 6*d*. net each. The first volume deals with the events of the years 1846–1855, and the second carries the history as far as 1865. We propose to review Mr. Paul's work when the third volume has been published, but we take this early opportunity of expressing our satisfaction that—following the example of John Richard Green—Mr. Paul records the work done in science in this country during the years with which he is concerned.

A SECOND edition of a "Manual and Dictionary of the Flowering Plants and Ferns," by Mr. J. C. Willis, has been published at the Cambridge University Press. In this edition the two parts of the original work are combined into one volume, while part i. is shortened by the omission of controversial matter, and by the use of smaller type for paragraphs of descriptive terms and other articles not intended for consecutive reading.

IN the Paris *Comptes rendus* for February 1 Messrs. Sabatier and Mailhe describe a method for the reduction of aromatic halogen derivatives by subjecting the vapours mixed with excess of hydrogen to the action of finely divided nickel at a temperature of about 270° C. In these circumstances considerable yields of benzene are obtainable from monochloro- and dichloro-benzene. Similarly toluene is easily obtained from the chlorinated toluenes, and trichlorophenol gives considerable quantities of carbolic acid. With bromine derivatives the reaction proceeds similarly, but not quite so readily as in the case of the chlorine substitution products.

IT is well known that the requirements of the fundamental law of mass action when applied to the electrolytic dissociation of salts, strong acids and bases are not satisfied, and in recent years many attempts have been made to account for this fact. In the Jubelband of the *Zeitschrift fur physikalische Chemie*, Prof. Rothmund attributes this to the incorrectness of the values for the degree of dissociation obtained by the usual conductivity and cryoscopic methods. A new method of obtaining the extent of dissociation is developed, and the author shows that in the case of the fairly strong picric acid the values so obtained are in agreement with the mass action law.

THE additions to the Zoological Society's Gardens during the past week include two Two-spotted Paradoxures (*Nandinia binotata*) from West Africa, presented by Mr. A. W. V. Crawley; a Common Paradoxure (*Paradoxurus niger*) from India, presented by Captain Robin; two Asiatic Deer (*Cervus asiaticus*) from Central Asia, presented by H.G. the Duke of Bedford, K.G.; three Hedgehogs (*Erinaceus europoea*), British, presented by Mr. M. Yearsley; a Hairy-footed Jerboa (*Dipus hirtipes*) from North-east Africa, presented by Mr. G. C. Kennedy; a Greater Sulphur-crested Cockatoo (*Cacatua galerita*) from Australia, presented by Mrs. Payne; a Ring-necked Parrakeet (*Palaeornis torquatus*) from India, a Rose-crested Cockatoo (*Cacatua moluccensis*) from Moluccas, a Childron's Snake (*Lialis childroni*) from Madagascar, deposited; a Kiang (*Equus hemionus*) from Tibet, purchased; a Sonnerat's Jungle Fowl (*Gallus sonnerati*) from Southern India; a Golden-bellied Grosbeak (*Pheucticus aurieventris*) from Argentina, received in exchange.

OUR ASTRONOMICAL COLUMN.

ASTRONOMICAL OCCURRENCES IN MARCH:—

Mar. 7. 16h. Venus in conjunction with Saturn. Venus of 20′ N.
8. 12h. Ceres in conjunction with the moon. Ceres 0° 29′ S.
16. 17h. 45m. Annular eclipse of the sun invisible at Greenwich.
18. 8h. 56m. Minimum of Algol (β Persei).
20. 13h. Sun enters the sign Aries. Spring commences.
21. 5h. 45m. Minimum of Algol (β Persei).
22. 10h. 0m. to 10h. 41m. Moon occults θ' Tauri (Mag. 3·9).
25. 9h. 2m. to 10h. 11m. Moon occults λ Geminorum (Mag. 3·6).
26. 22h. Jupiter in conjunction with Sun.

VARIABILITY OF MINOR PLANETS.—In *Circular* No. 75 of the Harvard College Observatory Prof. Pickering publishes and discusses the results of Prof. Wendell's observations of the minor planet Iris (7). The planet's magnitude was compared with several B.D. stars, and a variation, having a period of about 6h. 13m. and a range of about two- or three-tenths of a magnitude, was established. This variation closely resembles that of Eros, and the conditions for that planet, as discussed in *Circular* No. 58, are also applicable in the present case.

Prof. Pickering suggests that both Eros, which is now approaching its second stationary point, and Iris should be carefully watched.

Circular No. 64 from the Kiel Centralstelle announces that on February 16 Prof. Paliser discovered a decided variation in the magnitude of the minor planet Hertha (135), having a range of 0·5 mag., from 10·0 to 10·5. The following ephemeris is abstracted from one calculated by Dr. Neugebauer for 12h. Berlin M.T.:—

1904	α (h. m. s.)	δ (° ′)	log Δ
Feb. 29	9 29 30	+15 58·3	0·2948
Mar. 2	9 27 48	+16 4·9	
,, 4	9 26 9	+16 11·2	
,, 6	9 24 34	+16 17·1	
,, 8	9 23 4	+16 22·5	0·3047
	R.A. ±1m.	Dec. = ±5′·2.	

OBSERVATIONS OF VENUS DURING 1903.—In *Bulletin* No. 6 of the Lowell Observatory, Mr. Percival Lowell describes and discusses the objective reality of the markings seen by him on the surface of Venus during 1903. In the first place he discusses the possibilities of illusion on the part of the observer in seeing such faint details, but he has arrived at the conclusion that there are two kinds of *real* markings on this planet's surface. The first class includes the nicks running in from the terminator, the collar round the South Pole, and the two spots, Astoreth and Ashera, upon it. Of these Mr. Lowell has no doubts as to their reality, and from his observations of them he is assured that the period of rotation of the planet is 225 days. The second class of markings includes the long shades, such as Anchises regio and Hero regio, which, commencing at the terminator, run towards the centre of the disc. It is more difficult to confirm the objective reality of these markings, although from the permanence of their observed positions Mr. Lowell concludes that they are real features of the planet's surface. Measurements of the position angle, from the cusp, of the tip of Paris regio on the limb, when the longitude of the centre of the disc was between 79° and 86°, gave as a mean of sixteen measures on eight nights 19° 6′. The position angle of the tip of a marking to the left of this was determined as 27° 1′.

Mr. Lowell strongly insists upon the fact that the appearance of these markings is in no sense "canaliform"; they are not regular, not of even width, not dark or sharply defined, are never doubled, and they do not form a system of interlacing lines as do the "canals" of Mars. Four drawings of the planet's disc at different times are reproduced in the *Bulletin*, and a comparison of two of these made on April 14, 1903, with an interval of nearly six hours between the two observations, shows no change in the positions of the markings, thus indicating that in that interval the effects of the planet's rotation were imperceptible.

CATALOGUE OF NEW DOUBLE STARS.—Prof. R. G. Aitken has just published, in No. 50 of the Lick Observatory *Bulletins*, a sixth list of new double stars discovered by him during the systematic search he has prosecuted since 1899. The present list contains 216 new pairs, none of which appear in Prof. Burnham's General Catalogue. These doubles were discovered with the 36-inch and 12-inch refractors, 61 of them—several of which are separated by less than 0″·25—being credited to the smaller instrument. About 30 per cent. of the included stars have distances under 0″·50, 50 per cent. under 1″·0, and in more than 72 per cent. the distance of separation is less than 2″·0. The numbers assigned to the stars in the present list are in continuation of those in the former lists, and the star places are given for the epoch of 1900·0.

NOTES ON THE HISTORY OF THE METRICAL MEASURES AND WEIGHTS.

A TRADITION exists in this country that towards the end of the eighteenth century the French Government invited the English Government to cooperate in forming a joint committee for the measurement of the seconds pendulum at the latitude of 45°, which was to be used as a standard of length, and from this length a universal system of measures and weights was to be derived; the English Government having declined to accede to the request, the French savants took the matter in hand and devised the metre and its derivatives. Although this tradition existed, it did not appear to be easy to obtain documentary evidence with regard to it, and it was quite natural that Mr. Alexander Siemens, who was interested in the subject, should apply to the Royal Society in the expectation that some record of the transaction would be found in the minutes of council; these were searched, but without result.

Hearing accidentally of the application, I thought that I could at once place my hand on a reference that would settle the question, but found myself mistaken, so I concluded that I must have heard the statement made by one of my former professors, Hofmann or Frankland.

Having succeeded ultimately in tracing the early history of the negotiations and allied matters, it is possible that the following notes may be not without interest.

Inquiries amongst several friends being without avail, it struck me that there might be some record at the Foreign Office that would throw light on the subject; I therefore wrote to Lord Cranborne, then Under Secretary for Foreign Affairs, asking if the index of their foreign correspondence mentioned the matter. He replied that the correspondence was not indexed, and that it was now at the Record Office; he was also good enough to obtain for me a permit to search the original documents. Before I had proceeded very far in the search, Dr. R. T. Glazebrook suggested a reference to the book by Méchain and Delambre, "Base du Système métrique Décimal," Paris, 1806. In the introduction, or "Discours préliminaire," there occurs on p. 14 an extract from a decree of the National Assembly asking the King to write to His Britannic Majesty requesting him to submit the decree of the National Assembly to the English Parliament.

In vol. xxxiv. of the *Foreign Office French Correspondence*, January to June, 1790, at the Record Office, is a letter from the French Ambassador in England, the Marquis de la Luzerne, enclosing a copy of the decree of the National Assembly to the Duke of Leeds, the Secretary of State for Foreign Affairs.[1]

The Marquis de la Luzerne to the Duke of Leeds.

"Portman Square le 22 Mai, 1790.

"Le M^is de la Luzerne a l'honneur de faire bien des compliments à Monsieur le Duc de Leeds et se conforme aux ordres de sa Cour en lui envoyant ci-joint la copie d'un decret de l'Assemblée Nationale concernant les poids et mesures. Ces ordres lui prescrivent de faire au Ministère de sa Majesté Britannique les demandes qui y sont indiquées, et de l'assurer que le Roi son Maître verra avec satisfaction que Sa Majesté Britannique les juge de nature à être prises en considération.

"Décrét de l'Assemblée Nationale du 8 Mai, 1790.

"L'Assemblée Nationale desirant faire jouir à jamais la France entière de l'avantage qui doit résulter de l'uniformité des poids et mesures, et voulant que les rapports des anciennes mesures avec les nouvelles soient clairement determinés et facilement saisis, décrète que Sa Majesté sera suppliée de donner des ordres aux administrateurs des divers départemens du Royaume, à fin qu'elles se procurent et qu'elles se fassent remettre par chacune des Municipalités comprises dans chaque département, et qu'elles envoyent à Paris, pour être remis au secrétaire de l'Académie des Sciences, un modèle parfaitement exact des différens poids et des mesures élémentaires qui y sont en usage.

"Décreté ensuite que le Roi sera également supplié d'écrire à Sa Majesté Britannique, et de la prier d'engager le Parlement d'Angleterre à concourir avec l'Assemblée Nationale à la fixation de l'unité naturelle de mesures et de poids: Qu'en conséquence, sous les auspices des deux nations, des commissaires de l'Académie des Sciences de Paris pourront se réunir en nombre égal avec des Membres choisis de la Société Royale de Londres, dans le lieu qui sera jugé respectivement le plus convenable, pour déterminer à la latitude de quarante cinq degrés, ou toute autre latitude qui pourroit être préférée, la longueur du pendule, et en déduire un modèle invariable pour toutes les mesures et pour les poids; Qu'après cette opération faite avec toute la solemnité nécessaire, Sa Majesté sera suppliée de charger l'Académie des Sciences, de fixer avec précision pour chaque municipalité du Royaume, les rapports de leurs anciens poids et mesures avec le nouveau modèle, et de composer ensuite pour l'usage de ces municipalités des livres usuels et élémentaires où seront indiquées avec clarté toutes ces proportions.

"Décrète en outre que ces livres élémentaires seront addressés à la fois dans toutes les municipalités pour y être repandues et distribuées; Qu'en même tems il sera envoyé à chaque municipalité un certain nombre de nouveaux poids et mesures, les quels seront délivrés gratuitement par elles à ceux que ce changement constitueroit dans les dépenses trop fortes: Enfin que six Mois seulement après cet envoi, les anciennes mesures seront abolies et remplacées par les nouvelles.

"Collationnée à l'original par nous Président et Secrétaire de l'Assemblée Nationale à Paris le 9 Mai 1790. Signé Gouttes, curé d'Argilliers, Président, L'Abbé Colland de la Salcette, de Champeaux Palame, Le C^te de Crillon, Chabrond, de la Revelliere, de l'épaux, et de fermon, Secrétaires."

It will be observed that this decree does not specifically state that a new standard is to be introduced, but that the existing standards are to be corrected by one that has been compared with the length of the seconds pendulum.

Delambre states (*loc. cit.*) that the above decree was sanctioned on August 22, and that the Academy of Sciences nominated a commission consisting of MM. Borda, Lagrange, Laplace, Monge and Condorcet. He does not say that any reply was received from the English Government, and there is not any mention in the papers at the Record Office before the end of August that any reply had been sent.

It was considered probable that the reply, if any, might have been forwarded through the French Ambassador without having been recorded at the Foreign Office, or that the draft of the letter might have been lost. Sir Eric Barrington, Private Secretary to the Marquess of Lansdowne, very obligingly obtained, through the British Embassy at Paris, a copy of a letter from the Duke of Leeds to the Marquis de la Luzerne, dated December 3, 1790. On further search the draft of this letter was found in vol. xxxv. of the *Foreign Office French Correspondence*, July to December, 1790, at the Record Office, together with the note from the Marquis de la Luzerne reminding the Duke of Leeds of his letter of May 22.

The Marquis de la Luzerne to the Duke of Leeds.

"M. De la Luzerne a l'honneur de faire bien des compliments à Monsieur le Duc de Leeds et de lui rapeller qu'il a eu cetui de lui addresser, Le 22 mai dernier, par ordre

[1] The orthography and the accentuation of the original documents are here followed.

de sa cour, un office dont l'objet était d'inviter le Gouvernement Britannique à vouloir bien concourir avec le Gouvernement de France, à prendre les mésures qui seraient jugées respectivement les plus convenables, pour fixer l'unité naturelle des mesures et des poids. Si Monsieur le Duc de Leeds avait la bonté de faire connaître à M. de la Luzerne, les intentions de Sa Majesté Britannique sur ce point et de la mettre en état de satisfaire aux nouveaux ordres qu'il reçoit de sa cour, M. de la Luzerne lui aura beaucoup d'obligations.

"Portman Square, Le 30 9bre 1790."

The Duke of Leeds to the Marquis de la Luzerne.

"Le Duc de Leeds fait bien ses Complimens à Monsieur Le Marquis de la Luzerne, et a l'Honneur d'informer Son Excellence que les Mesures, dont Elle fait mention dans sa Note d'Hier, pour fixer l'Unité des Mesures et des Poids, doivent necessairement rester pour la Consideration du Parlement.

"A Whitehall, ce 1 Decre, 1790."

The same to the same.

"A Whitehall, ce 3 Décembre, 1790.

"Monsieur,

"Je n'ai pas manqué de rendre compte au roi de la note dont Votre Excellence m'a honoré du 22 mai, renfermant la copie d'un Décrêt de l'Assemblée Nationale, concernant l'Unité de Mesures et de Poids, qu'on souhaitoit de fixer, en concurrence avec le Parlement d'Angleterre; et j'ai l'honneur d'informer Votre Excellence qu'aiant, par ordre du Roi, fait faire des perquisitions à ce sujet, il paroit que l'affaire a été agitée dans la Chambre des Communes, vers la fin du dernier Parlement, mais qu'aucune proposition de la Chambre n'a été faite en conséquence.

"Il a souvent été question d'un tel arrangement parmi nos economistes publics, mais le projet a paru exposé à tant de difficultés que son accomplissement, tout désirable qu'il pourroit être, a été regardé comme presque impraticable.

"Il est superflu, Monsieur, d'assurer Votre Excellence de nouveau de la satisfaction avec laquelle le Roi sera disposé en tout tems de coopérer avec Sa Majesté très Chrètienne à tout ce qui pourroit être utile aux intérêts des deux royaumes.

"J'ai l'honneur d'être, avec la considération la plus distinguée,

"Monsieur,
"De Votre Excellence,
"le très humble et
"très obéissant serviteur
"[Signé] Leeds."

A Son Exce Mons. le Marquis De la Luzerne, &c. Consequence. On a écrit en marge—"Envoyé copie à M. Dupont, le 9 janvier, 1791.—"Envoyé copie au Comité des Poids et Mesures, le 25 prairial."

Archives des Affaires Etrangères. Correspondance d'Angleterre. Supplément, t. 18, pièce 66, fol. 353. Original.

The reference to the action taken in the previous Parliament is doubtless the motion made on February 5, 1790, by Sir John Riggs Miller,

"That the clerks of the market of the different cities and market towns throughout England and Wales, and the town of Berwick upon Tweed, and the clerks of the different counties of the same, do forthwith make out and transmit to the sheriffs of the respective counties in which the said towns are situated, returns of the different weights and measures now in use in their respective cities and market towns, as well as specifications and descriptions of any particular commodities that are bought and sold by any customary denominations or proportions of weight and measure, as far as such have come under their observation." "That the said order be sent to the sheriffs of the several counties in England and Wales, and be by them transmitted to the clerks of the markets in their respective counties; and that the said sheriffs do return to the Clerk of the House, to be by him laid before the House, the returns they shall receive from the clerks of the markets."

The speech by Sir John Riggs Miller is of much interest, and describes the confused condition in which the weights and measures in use in England were at that time. He said "He should not impose upon the House for the present an attention to a philosophical discussion, which would better suit a more advanced stage of the investigation, but content himself with merely acquainting them at that time, that the vibration of a pendulum would, he hoped, prove such a standard." The resolutions he proposed were unanimously agreed to. (*Parliamentary Register*, vol. xxvii. [marked 44 on the binding of the British Museum copy], 1790, pp. 41–48. *Parliamentary History*, vol. xxviii., 1816, cols. 315–323.)

On April 1, 1790, the House of Commons ordered that a committee be appointed to consider the several returns which shall have been or shall be made to the orders of the House of the 5th day of February last respecting the different weights and measures now in use in the several cities and markets throughout England and Wales and the town of Berwick upon Tweed, and to examine and report on the same, with their observations and opinions thereon, to the House.

Committee appointed accordingly.

The list of the members of the committee contains forty-three names, as well as all the members for Bristol, Liverpool, Hull, Glasgow, Lynn and Yarmouth, all the Knights for Shires, Gentlemen of the Long Robe, and Merchants in the House (*Commons Journal*, vol. xlv. p. 359).

On April 13, 1790, Sir John Riggs Miller made another speech to the House, in which he said that he had received a letter from the Bishop of Autun (M. Talleyrand de Périgord, afterwards Prince Talleyrand) encouraging him in his attempts to improve the weights and measures, and saying that "he took the hint of making his proposition to the National Assembly of France from what had been lately submitted to the British Parliament upon the same subject."

On this occasion Sir John Riggs Miller entered more fully into the question of standards, which he thought should be obtained from some natural length or some property of matter. He suggested that a certain number of drops of water or alcohol at a certain temperature might be used as a measure of weight, and that the length of the side of a cube which would contain the standard weight might be taken as a standard of length; as another standard, the distance through which a body would fall in one second; as another, the length of a degree of a great circle on the earth, but he thought that it would not be possible to measure this with sufficient accuracy; and lastly, what he calls the London pendulum of 39·126 inches.

Amongst general qualities that a standard should possess he stated, "It is desirable that its denomination should be in tens, to give it the advantage of whole numbers, or decimal fractions."

On the same day the reports of committees made in 1758 and 1759 on the original standards were ordered to be referred to the committee appointed on April 1. (*Parliamentary Register*, vol. xxvii. [marked 44 on the binding of the British Museum copy] pp. 395–403. *Parliamentary History*, vol. xxviii., 1816, cols. 639–649.)

This committee did not report; it is doubtful if it ever met, for a committee on standards of weights and measures which reported on July 1, 1814, states that the minutes of the proceedings of the committee of 1790 could not be found.

At the British Museum there is a volume of "Political Tracts," 1789–1790, which contains a pamphlet by Sir John Riggs Miller giving his speeches in the House of Commons, and several documents, amongst which are copies of letters from the Bishop of Autun (a copy of the same pamphlet is in the library of the Royal Institution). The letter to which he referred in his speech is as follows:

The Bishop of Autun to Sir John Riggs Miller.

"Paris, 28 Mars, 1790.

"J'ai appris, Monsieur, que vous aviés presenté au Parlement d'Angleterre un beau travail sur la Reduction des Mesures. J'ai cru devoir faire une Proposition sur le même sujet à notre Assemblée Nationale; je m'empresse di vous l'addresser, il me paroit digne de l'Epoque actuelle que les deux Nations se concertent pour la fixation d'une mesure

invariable, et quelles consultent ensemble la Nature pour arriver à ce résultat important.

"Si cette Idée vous paroit juste, Monsieur, si vous pensés qu'un grand bien doit en resulter, c'est à vous qu'il appartient d'en assurer le succès, et j'ose vous le recommendér : trop long temps les deux Nations se sont devisées pour de vaines pretentions ou de Coupables Interets, il est temps que deux Peuples libres assoçient leurs efforts et leurs Travaux pour une Recherche utile au Genre Humain.

"J'ai l'honneur d'être avec des
"Sentimens respectueux,
"Monsieur, votre très humble
"Et trés obeissant serviteur
"L'EVEC. D'AUTUN.

"To Sir John Riggs Miller, Bart.
"Member of the House of Commons, London."

(The English printer seems to have taken some liberties with the foreign language.)

Parliament was dissolved on June 11, 1790, so the committee ceased to exist, and it appears that Sir John Riggs Miller was not re-elected in the next Parliament.

I have been unable to ascertain the date when the Bishop of Autun made his proposition to the National Assembly, and if, in doing so, he referred to the action taken in the House of Commons. In the pamphlet of Sir John Riggs Miller is a reprint of a paper which the Bishop of Autun sent to all the members of the National Assembly, with a note attached saying that he considered that it would be preferable to print his proposition than to make a speech on the subject.

This paper contains the following paragraph, when referring to the measurement of the pendulum :—"Il m'est impossible de douter que l'Angleterre, qui dans ce moment paroît vouloir s'occuper de la reduction de ses mesures, avertie par votre détermination et invitée par vous, ne se réunire à la France pour l'exécution d'une entreprise que nos relations de commerce doivent rendre commune et dont le résultat doit appartenir un jour au Monde entier."

It will be a surprise to many to learn that there was any connection, even of the remotest kind, between the action of the British House of Commons and the proposition which ultimately led to the metrical measures and weights.

The committee that was appointed by the French Academy on August 22, 1790, reported on March 19, 1791 ("Histoire de l'Académie Royale des Sciences," Année MDCCLXXXVIII., published in 1791, pp. 7–16). The committee considered three proposed standards of length, the length of the seconds pendulum at the latitude of 45°, which was rejected in consequence of its involving the artificial element of time; the measurement of an arc of the equator, which was also rejected, because of the difficulties that would attend such an operation in an uncivilised country; and the measurement of an arc of the meridian, which was adopted, and the 10,000,000th part of the quadrant was selected as the standard of length.

The account given by Delambre of the measurement of the arc of the meridian from Dunkerque to Barcelona is most interesting; he was commissioned to measure the northern section whilst Méchain undertook the southern portion. Delambre left Paris with orders from the King, and before long he found them of little use; he had a difficulty in obtaining money for the expenses of the work, and at one time he was dismissed, as it was thought that his opinions were not in accord with those prevalent in Paris. Later he was permitted to continue the undertaking. He found that many of the church towers and spires which had been used in the survey of 1740, and which he intended employing again, had been destroyed; he could not use signal fires, for they were thought to be signals to the enemies of the country, and when he covered some of his stations with white sheets, so that they might be more visible at a distance, they were supposed to be standards of the counter revolution, and it was necessary to place blue and red bands on them to calm the suspicions of the populace. When Méchain had completed his work in Spain he was not allowed to return to Paris, and although he finished his portion of the survey, he died before the determination of the standards had been brought to a conclusion.

Notwithstanding all these adverse circumstances and disappointments, Delambre's account is remarkably free from bitterness.

It had been determined to submit the whole survey to a committee of foreign scientific men, so that it should have an international character, and the meeting was fixed for 15 vendémiaire an 7 (the 6th October, 1798); the survey, however, was not completed until about two months later. The account of the invitation to this final meeting is best given in Delambre's own words :—

"On a vu que le premier projet avoit été d'inviter la Société royale de Londres à concourir avec l'Académie des Sciences à la fixation de l'unité fondamentale; mais l'unité projetée étoit alors la longueur du pendule. La mesure de la méridienne étoit une entreprise bien plus considérable, et d'une trop longue durée pour qu'on pût se flatter de la voir terminer par les commissaires réunis des deux nations, lorsque tant de causes probables et prochaines pouvoit troubler la bonne intelligence entre leurs gouvernemens. L'événement ne prouva que trop tôt combien cette crainte étoit fondée. Mais les mesures terminées, avant d'en déduire les conséquences, il n'y avoit plus aucun inconvénient, on devoit au contraire trouver un avantage réel, à soumettre le travail à l'examen de tous les savans de l'Europe; et toutes les puissances amies ou seulement neutres furent invitées à nommer des députés à ce congrès d'une espèce toute nouvelle." (Méchain and Delambre, "Base du Système mètrique Décimal," Paris, 1806. Tome i. "Discours préliminaire," pp. 85–86.)

"Les savans étrangers venus pour prendre part à ces travaux étoient MM. Æneae et van Swinden, députés bataves; M. Balbo, député du roi de Sardaigne, remplacé depuis par M. Vassali Eandi, envoyé par le gouvernement provisoire du Piémont; M. Bugge, député du roi de Danemarck; MM. Ciscar et Pédrayés, députés du roi d'Espagne; M. Fabbroni, député de Toscane; M. Franchini, député de la République romaine; M. Mascheroni, député de la République cisalpine; M. Multedo, député de la République ligurienne, et M. Trallès, député de la République helvétique" (*loc. cit.* p. 92).

At that time England could not have been considered one of "les puissances amies," for war was declared by France against England in 1793, and continued for nearly nine years.

It has been the custom to discredit the Royal Society with having instigated the refusal of the French invitation, but there is no indication whatever that the matter was at any time referred to the society. The council minutes do not contain any mention of the invitation, and if the society had formally or informally suggested or approved of the refusal, it is inconceivable that the Duke of Leeds, who was at the time a member of the council, although a not very regular attendant at the meetings, would have omitted to mention such a support of his action. With regard to the absence of any English men of science on the last committee of revision, it seems certain, from Delambre's statement, that an invitation was not sent, and the minutes of the council of 1798 and 1799 are silent on the subject.

Without the kind assistance of others it would have been impossible for me to have obtained the information above given, and I take this opportunity of tendering my sincere thanks to the Marquess of Salisbury, Sir Eric Barrington, Sir Courtenay Ilbert, Dr. R. T. Glazebrook, the officials of the Royal Society and of the Public Record Office, for their help, and lastly to my former colleague, Prof. Alfred Lodge, who first put me on the right track by furnishing dates which much assisted the search.

HERBERT MCLEOD.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—The Sedgwick prize in geology is awarded to H. H. Thomas, B.A., Sidney Sussex College.

Z. U. Ahmad, B.A., Trinity College, has been elected to the Isaac Newton studentship in physical astronomy.

The Medical College, Lahore, has been added to the list of recognised schools of medicine.

A syndicate is to be appointed to draw up a scheme of instruction and examination in mining engineering, with a view to the requirements of the Coal Mines Regulation Amendment Act, 1903.

THE Secretary of State for War has, on the nomination of the Senate of the University of London, appointed Sir Henry Roscoe, F.R.S., to be a member of the War Office Advisory Board for Military Education, as a representative of the university.

THE King has been graciously pleased to promise a donation of 100 guineas in response to the appeal of the Senate of the University of London for funds to build and endow an Institute of Medical Sciences under the control of the university. A large sum is needed to carry out the scheme. Donations, which may be extended over a period of three years, should be sent to the honorary treasurers, Dr. J. K. Fowler and Mr. H. T. Butlin, at 35 Clarges Street, W.

THE Senate of the University of London has adopted the following resolution:—"That the Board of Education be informed that the Senate, while in no way wishing to cause any postponement of the appointed day, think it desirable, in the interests of education in London, that the University should be closely associated with the Education Committee to be appointed by the London County Council, and that persons experienced in education should be members of that committee."

THE new Paddington Technical Institute of the London County Council was opened by Sir Arthur Rücker on February 27. The premises have been acquired for a sum of 15,000*l*., and are now admirably equipped as a technical institute. Sir Arthur Rücker, in his address, said that the new institute represents what those in connection with the London University have long desired to see carried out—the union of the forces which have been engaged already in the work of teaching. What is being done at Paddington must be done on a larger scale elsewhere throughout the metropolis so as to bring the schools into closer contact with the university, for until the combination of forces was effected they could not realise the full advantages of the system they wanted to inaugurate. Cooperation will be the note of the education in the future. The chairman of the London Technical Education Board, in proposing a vote of thanks to Sir Arthur Rücker, mentioned that in the course of a short time it was intended to erect a power-house at the new institute and establish an engineering laboratory for the purpose of carrying on a motor-car school.

AT a meeting of the Senate of the University of Wales, held at Bangor, it was resolved to present an address of congratulation to Sir Henry Roscoe in connection with the forthcoming celebrations. It was also unanimously desired by the Senate that Principal Griffiths should represent the university in his official capacity of Vice-Chancellor at the opening of the new laboratories by the King at Cambridge. The memorial circulated by the Royal Society with reference to the teaching of science in schools was read by the Vice-Chancellor and discussed. A protracted discussion took place on a motion relating to the desirability of framing a scheme for the matriculation examination by which Latin would cease to be compulsory, and on a division taking place the motion was carried by a majority, a committee being appointed to bring the matter before the Senate in a more definite form later on. In connection with a recent petition presented to the University Court by the Mayor and an influential deputation from Swansea on behalf of the Swansea Technical College, a committee was appointed to draft a scheme, to be submitted to Parliament, for conferring on that college certain privileges of affiliation to the university.

LORD KELVIN distributed the prizes and certificates, gained during the past session, to the students of the Northampton Institute, Clerkenwell, on February 26. During the course of his address, speaking of the work of the London Technical Education Board, Lord Kelvin said:—"Many must feel regret that that board will cease to exist in the course of a few days. The new board which is to take its place will have all kinds of education under its charge—primary, secondary, and technical. It will need more money, and I hope it will be courageous and not fear to make a call on the rates when it is convinced that the payment of them will be for the benefit of the ratepayers." Continuing Lord Kelvin remarked:—"When you think of the great discoveries of Faraday in England and of Henry in America, and the succession of workers from their time to the present day who have added so much to our knowledge, you cannot help being struck with the enormous progress which science has made within a comparatively short period; and perhaps that progress has been even more remarkable and striking at the beginning of the twentieth century than during the whole of the nineteenth century. Many of these discoveries were for the moment in the realm of pure science, presenting no prospect of practical application; but what is to be thought of a scientific investigator who only looks for an immediate practical application of the result of his labours? The electrical discoveries of Faraday and Henry would never have been made if those great men had contented themselves with asking *Cui bono?*—who will benefit by them? The every-day workman would be all the happier for knowing something of the laws of nature developed in the work he is called upon to perform. The habit of mind of thinking scientifically and bringing scientific knowledge to bear on the practical work of life not only contributes to the work being well done, but also to the richness and mental wealth of the work."

THE Prince and Princess of Wales paid a visit on February 24 to the Battersea Polytechnic, on the occasion of the tenth anniversary of the opening of that institution by the present King. The Prince of Wales distributed the prizes and certificates gained by the evening students during the past year, and Her Royal Highness opened a number of new rooms which form an extension of the domestic economy department. Addresses of welcome were read by the chairman of the governing body of the polytechnic and by the Mayors of Battersea and Wandsworth. The Prince of Wales, in replying, pointed out how much the success of the London polytechnics was indebted, first, to the far-seeing thought of the Charity Commissioners, who twenty-one years ago suggested that the funds of certain ancient City charters should be devoted to the establishment in different parts of London of polytechnic institutes, and also to the City parochial foundations and the Technical Education Board of the London County Council. In the course of his address to the prize-winners, His Royal Highness remarked: "Probably at no time in the history of our country has there been a greater demand upon the intellectual powers than there is to-day. Keen competition and rivalry characterise the existing relations between communities and nations. Prof. Huxley some years ago pointed out with regard to our industries that we were in the presence of a new struggle for existence; and more recently Sir Norman Lockyer, in his address to the British Association last year, went further, and declared that the scientific spirit, the brain-power, must not be limited to the workshop when other nations utilise it in all branches of their administration, and he declared that universities and other teaching centres are as important as battleships and big battalions, and are, in fact, essential parts of a modern State's machinery." By thus directing attention to the principle that national development depends upon the provision made for the cultivation of brain-power, the Prince of Wales has advanced the plea put forward by Sir Norman Lockyer in his presidential address at Southport. The Prince evidently recognises that the progress of a nation is promoted by the forces of higher education and research; and his conviction should encourage far-seeing statesmen to face seriously the question of organising the forces which will make us equal to Germany or the United States in the struggle for commercial supremacy. It must be clearly understood that the scientific spirit—inquiring, critical, and progressive—is essential in the polity of a modern State; and for this reason it is to be hoped that the Prince of Wales's remarks will be well considered by our political leaders.

SOCIETIES AND ACADEMIES.

London.

Royal Society, January 28.—"The 'Islets of Langerhans' of the Pancreas." By H. H. **Dale**, M.A., B.C., George Henry Lewes Student. Communicated by Prof. Starling, F.R.S.

Since first described by Langerhans, in 1869, the "islets" have had various functions assigned to them, on the assumption that they are independent structures embedded in the pancreatic tissue, the prevalent view regarding them as ductless glands furnishing an internal secretion necessary for normal carbohydrate metabolism.

Lewaschew and others have stated that intermediate forms exist between the "islets" and the ordinary pancreatic alveoli, and that the abundance of islets and the prevalence of intermediate forms are increased by activity of the gland. Lagnesse described a conversion of secretory alveoli into islets and *vice versâ* during embryonic development.

These observations were made on the pancreas of the dog, cat, rabbit and toad, in conditions of rest, exhaustion, starvation, and after ligature of the duct. The tissue was hardened in a sublimate-formaldehyde mixture, cut in paraffin, and stained with toluidine blue and eosine.

In the resting pancreas of all the species examined, the intermediate forms described by Lewaschew were observed, and in the toad indications were found of a reconstruction of alveoli from islets.

In the condition of exhaustion, produced, in the mammalian pancreas, by intravenous injection of secretin during anæsthesia, in that of the toad by hypodermic injection of the same substance, a very extensive conversion of secretory alveoli into "islets" was observed, specimens being obtained from a dog with the greater part of a lobule, from a toad with the greater part of the whole pancreas so converted.

The effect of starvation, observed in a stray cat and in toads from the laboratory tank, was similar, but slighter in degree.

In the dog and rabbit, occlusion of the duct caused an interstitial fibrosis, the areas of tissue not destroyed assuming the "islet" condition. The preformed islets appeared to have no special immunity.

February 4.—"On the Origin of Parasitism in Fungi." By George **Massee** (Principal Assistant, Herbarium, Royal Gardens, Kew). Communicated by Sir William T. Thiselton-Dyer, K.C.M.G., C.I.E., F.R.S.

The hitherto unexplained problem as to why parasitic fungi are usually confined to one, or at most a few closely allied host-plants is shown to be due to chemotaxis. An extensive series of experiments was conducted with both parasitic and saprophytic fungi for the purpose of determining the positive or negative chemotactic nature of various substances occurring normally in plants. Among such may be enumerated saccharose, glucose, asparagin, malic and oxalic acid, and pectase. Practically the germ tubes of all fungi are positively chemotactic to saccharose, and the reason why all plants containing this substance are not attacked by every kind of fungus is because certain other substances present in the plant are negatively chemotactic or repellent to the germ-tubes.

Immune specimens of plants belonging to species attacked by an obligate parasite owe their immunity to the absence or small proportion of the substance chemotactic to the parasite. This discovery will assist in the production of immune strains of cultivated plants, all previous attempts in this direction having been conducted along lines of physical resistance.

Purely saprophytic fungi can be educated to become parasitic by sowing the spores on a living leaf that has had a substance positively chemotactic to the germ-tubes of the fungus experimented with injected into its tissues. By similar means a parasitic fungus can be led to attack a new host-plant.

These experiments prove what has hitherto only been assumed, namely, that parasitism on the part of fungi is an acquired habit.

Infection occurs more especially during the night or in dull damp weather, owing to the greater turgidity of the cells and to the presence in excess of the chemotactic substance in the cell-sap.

February 11.—"On Certain Properties of the Silver-Cadmium Series of Alloys." By T. Kirke **Rose**, D.Sc. Communicated by C. T. Heycock, F.R.S.

The attempts made at the Royal Mint to produce uniform standard trial plates of silver and copper have been unsuccessful owing to the segregation of the constituents. The cooling curve of the alloy shows that solidification begins at 900° and ends at 778° after passing through a pasty stage, during which rearrangement of the constituents can take place, with the result that the uniform distribution of the silver is disturbed. The cooling curve of the alloy containing 92·5 per cent. of silver and 7·5 per cent. of cadmium is found to resemble that of a pure metal, showing no appreciable pasty stage, and on testing plates made of these materials they were found to be uniform in composition. The alloy is exceedingly ductile, and no difficulty is encountered in making assays on it by any of the well-known methods. In preparing large ingots it is necessary to pour silver into a suitable amount of molten cadmium, this method minimising the loss of cadmium by volatilisation. The cooling curves and the microstructure of the whole series of alloys of silver and cadmium have also been studied, and evidence has been obtained of the existence of a number of compounds. The alloys containing from 100 to 80 per cent. of silver are homogeneous at all temperatures below the solidus curve, although they appear to contain two bodies between the solidus and liquidus curves.

"On the High Temperature Standards of the National Physical Laboratory: an Account of a Comparison of Platinum Thermometers and Thermo-junctions with the Gas Thermometer." By J. A. **Harker**, D.Sc. Communicated by R. T. Glazebrook, F.R.S.

This paper contains an account of a continuation of the work of Dr. P. Chappuis and the author (*Phil. Trans.*, A., 1900) on a comparison of the scale of the gas thermometer with that of certain platinum thermometers, from below zero to 600° C.

The results of this work confirmed the experiments of Callendar and Griffiths, and showed that the indications of the platinum thermometer may be reduced to the normal scale by the aid of Callendar's difference formula

$$d = T - pt = \delta[(T/100)^2 - T/100],$$

where pt is the platinum temperature, T the temperature on the normal scale, and δ a constant which, for pure platinum, is about 1·5.

The temperatures chosen for the determination of δ are 0° C., 100° C., and the boiling point of sulphur.

In the present paper the work is extended to a temperature of 1000° C., a number of standard thermo-junctions of platinum—platinum-rhodium being also included in the comparisons.

The gas thermometer employed for this work was presented to the laboratory by Sir Andrew Noble. The bulbs used were of porcelain, glazed inside and out, and the gas used was pure dry nitrogen. The thermo-junctions were carefully compared at a number of fixed points up to 960° C., before use, with concordant results. A special potentiometer designed and made in the laboratory enabled the thermo-junction readings to be taken with great accuracy.

The platinum thermometers employed were one of the three used by Harker and Chappuis in their earlier work, and a new one belonging to the British Association. The different instruments, after determination of their constants, were tested together in specially constructed electric resistance furnaces, heated from a special battery in which temperatures from 400°–1100° C. could be very steadily maintained for considerable periods. Special winding enabled a compensation to be made for the greater cooling effect at the ends of the furnaces, so that over a considerable length the temperature was exceedingly uniform.

The investigation shows that:—

(1) The readings of the platinum thermometers BA_2 and K_2, which may be taken as representative instruments, when reduced to the air scale by the use of Callendar's

difference formula, are, up to a temperature of 1000° C., in close agreement with the results obtained from the constant volume nitrogen thermometer, employing chemical nitrogen, and using the received value for the dilatation of the Berlin porcelain, of which the bulb is made.

(2) The platinum thermometers agree very closely with a set of thermo-junctions representing the temperature scale of the Reichsanstalt, based on measurements with a gas thermometer having a bulb of platinum-iridium.

As the results of these experiments seem to justify very completely the use of Callendar's parabolic formula over a wide range, a table has been calculated by which the value of T may be obtained directly from the value of *pt* for a range of temperature extending from −200°–1100° C., and for the value 1·5 of the constant δ.

"A New Method of Detecting Electrical Oscillations." By J. A. **Ewing**, LL.D., F.R.S., and L. H. **Walter**.

The paper describes a detector of electrical oscillations suitable for wireless telegraphy. It is based on Ewing's hysteresis tester, and employs the change which electrical oscillations produce in the hysteresis of a magnetic metal exposed to reversals of magnetism by means of a revolving field. The hysteresis causes the magnetic metal to be dragged after the field, and this drag is opposed by a spring, a definite deflection of the metal being thereby produced. When the oscillations act this deflection undergoes a sudden change which constitutes the indication.

Under the conditions first experimented on, the authors found, as they expected, a reduction of the hysteresis deflection when the oscillations acted. But in later experiments, when the magnetic metal was arranged in the form of a fine insulated steel wire through which the electrical oscillations were caused to pass, it was found that they produced a large increase in the deflection.

In the instrument exhibited the revolving field is supplied by an electromagnet with long wedge-shaped pole pieces between which a long bobbin of the steel wire is pivoted, so that the magnetic drag tends to make it turn on its axis. It is controlled by a spring and furnished with a mirror or other indicator of deflection. The bobbin is wound with about 500 turns of No. 40 gauge hard-drawn steel wire, insulated with silk, the winding being non-inductive. It is immersed in oil, which serves to steady the deflection as well as to reinforce the insulation.

The detector gives quantitative readings, and, in some cases, the deflection may be too large to be easily read by the scale. For this purpose a variable shunt is provided, by which the deflection can be regulated.

For the purpose of wireless telegraphy, the instrument has the advantage of giving metrical effects. The benefit of this in facilitating tuning, and in other respects, need not be insisted upon.

From the physical point of view, the augmentation of hysteresis is interesting and unlooked for. It is probably to be ascribed to this, that the oscillatory circular magnetisation facilitates the longitudinal magnetising process, enabling the steel to take up a much larger magnetisation at each reversal than it would otherwise take, and thus indirectly augmenting the hysteresis to such an extent that the direct influence of the oscillations in reducing it is overpowered. The net result appears to be dependent on two antagonistic influences, and, in fine steel wire, under the conditions of the experiments, the influence making for increased hysteresis, as a result of the increased range of magnetic induction, is much the more powerful.

Linnean Society, February 4.—Prof. S. H. Vines, F.R.S., president, in the chair. Mr. C. E. **Salmon** exhibited two specimens of *Epilobium collinum*, C. C. Gmel., from Scotland, with a series of *E. montanum* and *E. lanceolatum* for comparison.—The **President** gave an account of researches into the physiology of the yeast-plant (*Saccharomyces Cerevisiae*). He directed attention to the fact that though this plant consists of but a single minute cell it produces a variety of enzymes or ferments: *diastase, invertase, glucase, zymase*, as well as an undefined enzyme, *protease*, which digests proteid matter. The proteolytic activity of yeast has engaged the attention of many observers, of whom Hahn and Geret express the opinion that the plant contains a protease which resembles, in some respects, the pepsin of the animal body, in other respects the trypsin. In November, 1902, the discovery of a protease resembling the recently discovered *crepsin* of the animal body was announced by the president. Since then he has endeavoured to determine whether or not the proteolytic phenomena of yeast may not be due in part to the presence of an enzyme of this character, with results which indicate that this is the case. A filtered watery extract of yeast readily decomposes the simpler proteids, such as albumoses and peptones, into non-proteid bodies, such as leucin, tyrosin, &c., as indicated by the tryptophane-reaction. Such an extract was, however, in no case observed to exert any digestive action upon a higher proteid, such as fibrin. The conclusion to be drawn is that the protease extractable from yeast by water is an erepsin. Yeast contains a protease that digests fibrin. If yeast be extracted with a 2 per cent. solution of common salt, a liquid is obtained which digests fibrin with certainty. What, now, is the nature of this protease that digests fibrin? Though the point can only be finally settled by separating and isolating the two proteases, the probability is that this peptonising enzyme is a vegetable trypsin. The conclusion suggested by the observed facts is that yeast contains at any rate two proteases, the one an erepsin, the other probably a trypsin.—Mr. E. S. **Salmon** gave an account of his further researches on the specialisation of parasitism in the Erysiphaceae. The comparative inoculation experiments of 1050 leaves of various species of Bromus, carried out by the author, have shown that a very high degree of specialisation has been reached in the adaptive parasitism of *Erysiphe Graminis*, DC., to the different species of the genus Bromus. This specialisation has involved the evolution of a considerable number of "biologic forms" of the fungus. The facts obtained show not only the high degree of specialisation which the fungus has undergone, but also that each species of Bromus possesses distinctive physiological characters existing concomitantly with the specific morphological characters.

Physical Society, Feb. 12.—Annual general meeting.—Dr. R. T. Glazebrook, F.R.S., president, in the chair. The president delivered an address in which he dealt with one or two matters connected with the theory of the microscope.

Edinburgh.

Royal Society, January 4.—Prof. Duns in the chair.—In a paper on the bilateral origin of the epiphysis in the chick, Dr. John **Cameron** showed that the epiphysis in the chick arises in the form of two bilateral outgrowths, of which the left is by far the better marked of the two. These results correspond in their main features with those already obtained by the author in the case of the Amphibia. The evidence is gaining ground that the epiphysis is bilateral and not mesial in origin.—Prof. A. C. **Mitchell** gave an account of a multi-metre resistance bridge, which he had constructed for investigations in which very strong currents were to be used. There were some special features for securing steady pressure contact. The many standard coils which could be arranged in a great variety of ways were loosely wound in long coils, and the temperature was determined by the change of resistance of a platinum coil wound similarly in the heart of the collection of resistance coils. The coils were made of Beacon wire, and had all been carefully standardised by the Board of Trade.—Two mathematical papers by the Rev. F. H. **Jackson** dealt with certain fundamental power series and their differential equations, and an additional note on generalised functions of Bessel and Legendre.

January 18.—Dr. Robert Munro in the chair.—Prof. Graham **Kerr** read a paper on the early development of motor nerves and myotomes in *Lepidosiren paradoxa*, Fitz. Photographs taken from untouched negatives were shown illustrating the following points:—(1) the fact that the motor nerve trunks existed as metamerically repeated bridges of granular protoplasm at a period when myotome and spinal cord were still in contact; (2) that the nerve trunk was at first naked; (3) that later on it received a covering of yolk-laden mesenchymatous protoplasm which spread itself out and formed a continuous protoplasmic sheath; and (4) that at certain stages complete continuity

could be observed between motor nerve trunk and the protoplasmic body of the myoepithelial cell, of which, indeed, the former was merely a tail-like prolongation. In regard to the myotomes, it was pointed out that the greater part of the fully-formed muscle segment was derived from the *outer* wall of the myotome.—Dr. T. H. **Bryce** read a paper on the histology of the blood in the embryo of *Lepidosiren paradoxa*, part i., structure of the resting and dividing corpuscles. The material loaned by Prof. Graham Kerr is exceptionally advantageous for the study of cell structures. The large red corpuscles, 50μ in diameter, have a definite fibrillar structure, with a broad fibrillar equatorial band round the equator in the resting disc-shaped corpuscle. The nucleus has a very coarse chromatin network which stains differently from that of all the other nuclei, taking in acid and basic mixtures only the acid dye. The chromosomes in mitosis react similarly. No centrosome is present in the disc-shaped corpuscle, but it appears as a double body with exceptional distinctness in oval and round corpuscles. As all stages between the flat disc and the round corpuscles are found, it is probable that the disc rounds up before division, and as the centrosome disappears when division is even, that it is formed afresh at each division. The leucocytes are found in several varieties—a small mononuclear hyaline corpuscle, a large mononuclear form with distinct protoplasmic meshworks basophil in reaction, and polymorphonuclear granular corpuscles. The granules are eosinophil, vary much in size, and accumulate in the cytoplasm until it is entirely filled with them. These corpuscles are actively amœboid, and each possesses a large permanent centrosome and attraction sphere, evidently related to the amœboid movements.—A paper by Mr. E. J. **Bles**, on the development of Xenopus, was also read, and was fully illustrated by a fine series of lantern slides.

PARIS

Academy of Sciences, February 22.—M. Mascart in the chair.—On some points in the theory of algebraic functions of two variables and their integrals: Émile **Picard.**—Refractometric studies relating to the constitution of methinic cyano-acids: A. **Haller** and P. Th. **Muller.** The introduction of negative radicles into neutral molecules such as camphor, acetoacetic and malonic esters gives rise to substances of clearly acid function to which the name of methinic acids is applied. Ten of these compounds, in which the negative radicle is cyanogen, have been prepared and their refraction and dispersion measured, with a view to throwing light on the question as to whether they possess a ketonic or enolic constitution. It is shown that the experimental numbers approach more nearly those calculated on the assumption of the enolic formula than those required for the ketonic formula. It is possible, however, that some of the divergences noted may be due to the association of three negative groups with the same carbon atom.—On the genus Ortmannia, and the mutations of certain Atyides: E. L. **Bouvier.** The author regards *Ortmannia Henshawi* as being a mutation of *Atya bisulcata*, which presents the peculiarity of recalling the immediate ancestral form of the Atya.—The action of human serum on some pathogenic trypanosomes; the action of arsenious acid upon *Tr. gambiense*: A. **Laveran.** It has been shown by Dutton and Todd that the trypanosome obtained from horses in Gambia and *Tr. gambiense* are probably not identical, and the author has found that these two pathogenic trypanosomes are clearly differentiated by their reaction towards human serum. The former is clearly though slightly affected by human serum, whilst *Tr. gambiense* is completely refractory. An experimental study of the various remedies that have been suggested for the amelioration of trypanosomiasis shows that arsenious acid is the only one possessing marked effect, and this is required in large doses. It is possible that treatment with this in the early stages of sleeping sickness, before nervous lesions have commenced, may lead to a cure.—The photographic registration of the action produced by the *n*-rays on a small electric spark: R. **Blondlot.** Reproductions are given of negatives showing the increase in the actinic action of the electric spark by the action of the *n*-rays, and also showing that the rays emitted by a Crookes's tube are polarised. Details of the precautions necessary to obtain successful results are also given.—The direct addition of hydrogen to aniline: the synthesis of cyclohexylamine and of two other new amines: Paul **Sabatier** and J. B. **Senderens.** The vapour of aniline, treated with an excess of hydrogen in presence of reduced nickel at 190° C., gives ammonia, cyclohexylamine, $C_6H_{11}NH_2$, dicyclohexylamine, $(C_6H_{11})_2NH$, and cyclohexylaniline, $C_6H_5.NH.C_6H_{11}$, the two latter being new. A description is given of the physical properties of these amines, together with the preparation of the carbonates and hydrochlorides.—On the soils of fossil vegetation of Sigillaria and Lepidodendron: M. **Grand'Eury.**—On a group of problems in geometry: C. **Guichard.**—On suites of analytical functions: P. **Montel.**—On the representation of functions by rational fractions: R. de Montessus **de Ballore.**—On the fragility of metals: A. **Perot** and Henri Michel **Levy.** In a former paper the authors have given a new method for measuring the effects produced by shock in notched test-pieces. In the present paper the results of the application of this method to two metals are given, and it is shown that differences in properties can be thus brought out which are not detected by the ordinary methods of testing.—The part played by the corpuscles in the formation of the anodic column in tubes of rarefied gases: H. **Pellat.** From the author's experiments the conclusion is drawn that the luminescence of a gas to which the name of anodic column is given follows exactly the trajectory which would be expected for the negative corpuscles, and has no relation with that of the positive ions. A reproduction of two photographs showing the appearances observed with hydrogen and oxygen tubes accompanies the paper.—The laws of the anomalous propagation of light in optical instruments: G. **Sagnac.**—The relation between diffusion and viscosity: J. **Thovert.** The diffusion constant, D, and the viscosity, *t*, were measured for a 1 per cent. solution of phenol in various solvents, and it was found that the product D*t* was a constant.—Contribution to the study of audition: M. **Marage.** The study of the ear in a pathological state has led the author to propose some modification in Helmholtz's theory of hearing.—On the spectrum of the arc: C. **de Watteville.** The method of Fleming and Petavel, devised to study the luminous intensity of the electric arc produced by an alternating current, is applied to a study of the spectrum under similar conditions. The modifications produced are such that the arc spectrum approaches in character that of the flame spectrum.—On disruptive discharge at very high pressure: J. **de Kowalski.**—A new receiver for wireless telegraphy: N. Vasilesco **Karpen.**—On the *n*-rays emitted by an electric current passing through a wire: P. **Jégou.** The rays were put in evidence both by the effect on the lustre of phosphorescent calcium phosphide and by the action on a blue gas flame.—The study of the law of photographic development as a function of the time: Adrien **Guébhard.**—A new improved type of chronograph: Robert Ludwig **Mond** and Meyer **Wildermann.** In this chronograph the cylinder is fixed, and the style, with the electromagnet which actuates it, rotates round the cylinder. With a cylinder 60 cm. long, a record lasting fifty minutes, and with an accuracy of 1/50th of a second, can be obtained.—On the specific potentialisation and the concentration of energy: Ernest **Solvay.**—Experimental researches on distillation: Eug. **Charabot** and J. **Rocherolles.** A study of the theory of steam distillation.—On the manganimanganates of the alkaline earths: V. **Auger** and M. **Billy.**—The action of carbonic acid on solutions of sodium nitrite: Louis **Meunier.** The author controverts the conclusions of MM. C. Marie and R. Marquis, and shows that the liberation of nitrous acid in their experiments was due to the presence of potassium iodide in their solutions.—On mannamine, a new base derived from mannose: E. **Roux.** Mannose is converted into its oxime by means of hydroxylamine; this is reduced, and the amine separated in the form of the oxalate. Several salts and derivatives of the new base are described.—Researches on ricinine: L. **Maquenne** and L. **Philippe.** The formula $C_8H_8N_2O_2$ is ascribed to this compound, which is the methyl ester of ricininic acid. The latter acid appears to be the carboxyl derivative of an iminomethylpyridine.—On the inversion of sugar: L. **Lindet.**—On the simultaneous existence in living cells of diastases which possess both oxidising and reducing properties, and on the oxidising power of re-

ductases: Emm. **Pozzi-Escot.** A claim for priority as against MM. Abelous and Aloy.—On the development of the vascular cryptogams: G. **Chauveaud.** The stem of the fern is constituted by the fusion of different parts, varying in number according to the level considered.—On the systematic position of the endophytes of orchids: I. **Gallaud.** Several authors have obtained from the roots of orchids fungi allied to Fusarium, but these would appear to have been external; the endophytic forms obtained from the cells of the orchid are distinct from Fusarium.—The mycelium and conidian form of the Morel: Marin **Molliard.**—On the age of the human skeletons from the caves of Mentone: Marcellin **Boule.** The skeletons would appear to be of the same age as the deposits in which they were found, corresponding to the warm and most ancient period of the Quaternary. Other skeletons found in higher layers correspond to later periods of the same formation.—On a tunnel at Oupliz-Tsike, Transcaucasia: E. A. **Martel.**—Researches on the emission of the *n*-rays in certain phenomena of inhibition: Aug. **Charpentier** and Ed. **Meyer.**—The action of the radium radiations on colloids, hæmoglobin, ferments, and the red corpuscles: Victor **Henri** and André **Mayer.** The β-rays, charged negatively, can precipitate positive colloids, and are without action on negative colloids. Oxyhæmoglobin from the dog and the frog is transformed into methæmoglobin and slowly precipitated; carbonoxyhæmoglobin remains unaltered. Ferments under the action of the rays slowly lose their activity, and after several days become completely inactive.—The emission of the *n*-rays in certain pathological cases: Gilbert **Ballet.**—The influence of the radium radiations on the toxicity of snake poison: C. **Phisalix.** The rays emitted by radium exercise an attenuating influence on snake poison, the intensity of which is a function of the time.—A physical and chemical method of recognising and measuring deep submarine currents: M. **Thoulet.**—Some new observations on phthiriosis in the vine: **L. Mangin** and P. **Viala.**—On the effects of grafting on the vine: Lucien **Daniel** and Ch. **Laurent.**

DIARY OF SOCIETIES.

THURSDAY, March 3.

Royal Society, at 4.30.—An Inquiry into the Nature of the Relationship between Sunspot Frequency and Terrestrial Magnetism: Dr. C. Chree, F.R.S.—The Optical Properties of Vitreous Silica: J. W. Gifford and W. A. Shenstone, F.R.S.—A Radial Area-Scale: R. W. K. Edwards.—The Origin of the Flutings in the Spectra of Antarian Stars: A. Fowler.

Royal Institution, at 5.—Electrical Methods of Measuring Temperature: Prof. H. L. Callendar, F.R.S.

Röntgen Society, at 8.30.—Presidential Address: Some Laboratory Notes of the last Six Months.

Linnean Society, at 8.—List of the Species of Carex known to occur in Malaya: C. B. Clarke, F.R.S.—On some Species of the Genus Palæmon, Fabr., from Tahiti, Shanghai, New Guinea, and West Africa: Dr. J. G. de Man.

Chemical Society, at 8.—Chemical Dynamics of the Alkyl Iodides: Miss K. A. Burke and F. G. Donnan: The Constitution of Phenolphthalein: A. G. Green and A. G. Perkin.—δ-Ketohexahydrobenzoic Acid: W. H. Perkin, junr.—Photochemically active Chlorine: C. H. Burgess and D. L. Chapman.

FRIDAY, March 4.

Royal Institution, at 9.—Breathing in Living Things: Prof. W. Stirling.

Geologists' Association, at 8.—Remarks on the British Association Geological Photographs: Dr. C. Gilbert Cullis.

SATURDAY, March 5.

Royal Institution, at 3.—The Life and Work of Stokes: Lord Rayleigh.

MONDAY, March 7.

Royal Institution, at 5.—General Monthly Meeting.

Aristotelian Society, at 8.—Faith and the Will to Believe: L. T. Hobhouse.

Society of Chemical Industry, at 8.—Observations on Cotton and Nitrated Cotton: H. de Mosenthal.—The Products, and Relative Temperature of Combustion of some Smokeless Powders: W. Macnab and A. E. Leighton.

Royal Geographical Society, at 8.30.—Journeys on the River Yalu and in Southern Manchuria: R. T. Turley.—About Korea: Rev. C. T. Collyer.

Society of Arts, at 8.—Recent Advances in Electro-Chemistry: Bertram Blount. (Cantor Lecture, I).

Victoria Institute, at 4.30.—Date of the Last Rise of the Land in the British Isles: Prof. E. Hull, F.R.S.

TUESDAY, March 8.

Royal Institution, at 5.—Japanese Life and Character: E. Foxwell.

Institution of Civil Engineers, at 8.—The Erection of Iron Bridges: R. S. Scholefield.

Anthropological Institute, at 8.15.—The Gilyaks and other Tribes of Sakhalin: C. H. Hawes.

WEDNESDAY, March 9.

Society of Arts, at 8.—Mechanical Piano Players: J. W. Coward.

Geological Society, at 8.—On the Probable Occurrence of an Eocene Outlier off the Cornish Coast: Clement Reid, F.R.S.—The Valley of the Teign: A. J. Jukes-Browne.

THURSDAY, March 10.

Royal Institution, at 5.—Electrical Methods of Measuring Temperature: Prof. H. L. Callendar, F.R.S.

Mathematical Society, at 5.30.—On Inner Limiting Sets of Points: Dr. E. W. Hobson.—On the Unique Expression of a Quantic of any Order in any Number of Variables with an Application to Binary Perpetuants: Mr. P. W. Wood.—The Derivation of Generalised Bessel Coefficients from a Function Analogous to the Exponential: Rev. F. H. Jackson.—Illustrative Examples of Modes of Decay of Vibratory Motions: Prof. A. E. H. Love.

Institution of Electrical Engineers, at 8.—The Railway Electrification Problem and its Probable Cost for England and Wales: F. F. Bennett.—The Rated Speed of Electric Motors as affecting the Type to be Employed: H. M. Hobart.

Society of Arts, at 4.30.—China Grass; its Past, Present, and Future Frank Birdwood.

FRIDAY, March 11.

Royal Institution, at 9.—The Motion of Viscous Substances: Prof. F. T. Trouton, F.R.S.

Institution of Civil Engineers, at 8.—The Premium System of Payment for Labour: W. G. Banister.

Physical Society, at 8.

Malacological Society, at 5.—A *Résumé* of Recent Researches on the Structure of Pelecypod Gills: Dr. W. G. Ridewood.—Descriptions of two new Species of Opisthostoma from Borneo: E. A. Smith.—On some Non-Marine Hawaiian Mollusca: C. F. Ancey.—New Species of Mollusca from New Zealand: Rev. W. H. Webster.

SATURDAY, March 12.

Royal Institution, at 3.—The Life and Work of Stokes: Lord Rayleigh.

CONTENTS.

THURSDAY, MARCH 10, 1904.

THE ANIMALS OF INDIAN GARDENS.

Some Indian Friends and Acquaintances: a Study of the Ways of Birds and other Animals Frequenting Indian Streets and Gardens. By Lieut.-Colonel D. D. Cunningham, C.I.E., F.R.S. Pp. viii+423. (London: John Murray, 1903.) Price 12*s.* net.

BOOKS on the animals, birds especially, that abound in Indian gardens tend to become numerous. This is not surprising, for the wealth of animal life to be found in Indian cities, and especially in suburban gardens, far exceeds anything known in Europe. Not only is the fauna much richer, but, as Colonel Cunningham points out, all animals are tamer and are protected by the human inhabitants of the country, "who," as he says, "are free from the desire to capture or kill any strange or beautiful living thing that they may meet with, who have no youthful hereditary instinct for bird-nesting, and in mature life no natural appreciation of 'murder as a fine art.'"

Whether the last phrase is quite correctly applied to a race amongst whom Thugs and Dacoits flourished at no distant period in the past may perhaps be open to doubt, but there is no question that veneration for animal life is a living principle amongst Hindoos and Buddhists, and consequently that in but few countries in the world are wild birds and beasts more familiar than in India.

The richness of the vegetation in Indian gardens will in a few months, if not checked, convert any vacant space into a thicket, and the cover that is thus produced affords a great attraction to the wild animals of the neighbourhood. Calcutta, where most of Colonel Cunningham's notes were made, has a richer fauna and flora than Indian cities in general, and amongst its suburban gardens are the beautiful Botanic Gardens of Shibpur, which are unsurpassed in India, and the fauna of which has long been almost as famous as the flora.

Of the opportunities afforded by Calcutta suburban gardens for the observation of birds and other animals Colonel Cunningham has made admirable use, and his notes may be fairly compared with Aitken's well-known "Tribes on My Frontier" and "A Naturalist on the Prowl." So far as it has been possible to check the accounts in the present work, all the animals, birds, beasts, reptiles, batrachians and fishes are correctly identified, and the accounts of their habits are from actual observation, not, as is so frequently the case, from tales told by imaginative natives of the country. Only one instance has been met with in which Colonel Cunningham's experience is opposed to that of other writers. He says that tree-snakes, *Dryophis mycterizans,* are "decidedly ill-tempered animals and very ready to bite" (p. 338). The experience of the present writer is precisely the contrary, but there is probably some explanation of the difference.

It is true that many of the observations now recorded have been made by other writers and published in older works, but they are so interesting that they will bear repeating, and the liability of all observers to error in noting the habits of wild animals is so great that it is only by repeated observations that accuracy can be attained. Moreover, many of the facts noticed, even if they have been observed before, are not generally known. As an instance of such contributions to natural history the following account of the device adopted by a pair of "koils," the famous Indian fruit-cuckoos, when engaged in laying eggs in the nests of crows may be quoted. It is, of course, well known that the sexes in the koil differ much more than they do in the majority of cuckoos, the male being glossy black, the female speckled brown, and it is extraordinary that a bird of inferior intelligence and inferior pugnacity should succeed in foisting its eggs on a crow, its superior in both respects.

"The order of events is this: when everything is ready and a desirable nest has been chosen, the cock-koil, conspicuous in his shining black plumage and crimson eyes, seats himself on a prominent perch, whilst the hen, in modest speckled grey garb, lurks hidden amongst dense masses of neighbouring foliage. He then lifts up his voice and shouts aloud, his voice becoming more and more insistent with every repetition of his call, and very soon attracting the attention of the owners of the nest, who rush out to the attack and chase him away. Now comes the chance for his wife, who forthwith nips in to deposit her egg. Very often she does this successfully before the crows have returned, but every now and then she is caught in the act, and driven off, like her husband, uttering volleys of shrill outcries."

Many of the notes on snakes are interesting, and as in this case even the "snake-stories" may be believed, one may be quoted.

"When there was much demand for stores of dried venom for European laboratories, the old snake-man in the Zoological Garden at Alipur was sent out every autumn to collect as many snakes as possible for use during the ensuing winter. His excursions generally lasted for a week or two, and then he would return laden with sacks full of snakes. Once he came back in great triumph bringing a hundred and fifty cobras, and it was a gruesome sight to watch him loose the mouth of one of his sacks and plunge his arm down into it in order to haul out one after another of his prisoners. . . . The cobras were so crowded and hampered in their confined quarters as to be quite unable to raise their heads and necks for the downward stroke with which they normally lay hold, and the man knew so well where and how to seize them, that the chance of his being bitten was really very small."

It is to be regretted that the plates in this book are by no means so good as the text. Some afford a fair idea of the birds or other animals represented, though even in this case, as in the two coloured views of adjutants by day and at roost, the figures are sometimes caricatures, and the majority appear to be copies of indifferent Indian native drawings. Colonel Cunningham is too good an observer not to be aware that neither the colour nor the relative position of the head, wings, and body during flight of the Indian swifts represented in Plate xiv. is correct, that the ants on Plate vi. (p. 112) should not be shown as larger than the eggs of the blue-throated barbet, and that the crow in the front of the plate opposite p. 60 ought to

have the head and neck grey and not black like the "corbies" in the background. There is evidently some error about these figures, for they are referred to throughout the book as Plates i., ii., &c., whilst the corresponding numbers are only marked on them exceptionally and sporadically.

But although the illustrations are not so good as could be wished—and all who have had experience in similar matters know how very difficult it is to secure good figures of animals—the perusal of the present book may be recommended to all who are interested in the animal life of India. W. T. B.

ENGINEERING SCIENCE.

Strength and Elasticity of Structural Members. By R. J. Woods, M.Inst.C.E. Pp. xi+310. (London: E. Arnold, 1903.) Price 10s. 6d. net.

DURING the last fifteen years there has been a rapid growth in the number of engineering students taking a full course at one or other of the many institutions in Great Britain and America which offer instruction in the necessary subjects, and as a result there has been a steady stream of text-books written especially for this comparatively new class of college students. The strength and elasticity of materials is a branch of engineering science which must be thoroughly mastered by every student, no matter to what branch of engineering he eventually proposes to devote himself. It is not surprising, therefore, that a number of text-books devoted to this subject have been published during the past few years, and it is hence a somewhat difficult matter for any author to show much originality in his treatment of the problems which have to be solved. Mr. Woods has, however, been able to deal with several points in a fresh and interesting manner. The book will be especially valuable to the private student on account of the very excellent series of examples at the end of each chapter, with the solutions given in every case.

The first chapter is devoted to graphical statics, and after simple definitions of the triangle and polygon of forces, the funicular polygon, and the graphical conditions of equilibrium, the methods of solution are explained, and then applied to the practical problems of the graphical determination of stresses in roofs, girders, and framed structures. In the next three chapters the relations between stress and strain are very fully and carefully discussed, the properties of the ellipse of stress are deduced, and the results are applied to the determination of the principal stresses in a beam. In a text-book of this nature it is very important that complete tables should be given of the weights, strengths, and other properties of the various materials used by engineers in structural work, and it may be well to point out that the tables given on pp. 72 and 73 might have been considerably increased, and certainly would have been improved, by the addition of a column giving the elastic limit in tension for such materials as wrought iron, mild steel, &c.

In dealing with bending and bending moments, a slight inversion of the actual order adopted would probably have facilitated the reading of the private student, that is to say, in chapter v. it would have been better to have placed the formulæ connecting stress and bending moment at the end rather than at the beginning, after all the preliminary work of determination of bending moment, drawing of shear and bending moment diagrams, &c., had been fully treated. The author has introduced into the chapters dealing with beams the graphical methods for finding the equivalent area or modulus of section of beams; this useful piece of work is too often omitted from the ordinary text-books.

As the book was originally written in the form of a series of lectures for students at the Royal Indian Engineering College, it naturally deals with one or two branches of the subject not usually considered in elementary text-books; for example, stresses at the joints in masonry structures, stresses due to earth pressure at the back of retaining walls, and the strength and design of riveted joints for structural work, are all fully discussed. The book is a good, clearly written text-book, and will probably be a useful work of reference not only to the engineering student, but to those engaged in actual practical work.

T. H. B.

SCHOOL GEOMETRY.

Theoretical Geometry for Beginners. Part iii. By C. H. Allcock. Pp. viii+113. (London: Macmillan and Co., Ltd., 1904.) Price 1s. 6d.

Elementary Geometry. Section iii. By Frank R. Barrell, M.A., B.Sc. Pp. viii + 285 to 360. (London: Longmans, Green and Co., 1904.) Price 1s. 6d.

Rudiments of Geometry for Junior Classes. By M. Wilson. Pp. 228. (London: W. R. Russell and Co.) Price 1s. net.

Geometry on Modern Lines. For Elementary Students. By E. Springfield Boulton, M.A. Pp. viii+126. (London: Methuen and Co., 1904.) Price 2s.

THE text-book by Mr. Allcock, of which part iii. is now issued, is an excellent substitute for Euclid for those teachers who wish to confine attention mainly to deductive geometry. Experimental and practical work is not entirely omitted, but it occupies a very subordinate place. The book is very attractive on account of its admirable and incisive style and the beautifully clear manner in which it is got up and printed, and it cannot fail to give satisfaction wherever adopted. The present part includes the more important propositions of Euclid, Book ii., also Book iii., Props. 35–37, and Book iv., Props. 10–16. In many cases the algebraical equivalents follow the geometrical proofs, and mutually illustrate one another. In some of the propositions it would have been a great advantage if simple trigonometrical equivalents could also have been given. A useful chapter on the radical axis is included, and answers to the numerical examples are collected at the end of the book.

The geometry by Mr. Barrell displays very commendable originality in the manner of presentation.

The concluding section treats of solid geometry, after Euclid xi., and of the mensuration of simple solids. Particular care has been taken in regard to the figures; they are drawn in oblique parallel or metric projection, are lightly shaded, and are very effective indeed. A few problems on the setting out of such figures to scale, and of the measuring of dimensions from them, would have been interesting and instructive. Also in this section we should like to have seen some account of the graphic representation and measurement of position in space by means of orthogonal projections. In the geometry of the prism, pyramid, wedge, cylinder, cone and sphere, geometrical, algebraical and trigonometrical methods are very happily and naturally combined, resulting in a fuller treatment than is usually met with in similar text-books; many well selected numerical examples are worked out. The prismoidal formula is explained and applied to specific cases. Altogether the author is to be congratulated on the production and completion of a very excellent text-book of elementary geometry on modern lines.

In the "Rudiments of Geometry" the author gives a course which she claims to have introduced successfully at the Municipal Technical School, Gravesend. It is based on experimental work, and is carried on along with practical geometry. Specific drawing exercises are set, and the pupils are required in each case to write out in their own words an account of what they have done, and of any inferences or discoveries they may have made. Formal proofs then follow, and are intended to be based on the collective suggestions of the class; these in turn are reproduced on paper by each boy or girl independently. There are two appendices containing between four and five hundred exercises in geometry. In these the old school of art course is too prominent. It seems to us that the scheme of the book is unduly extended, and that the work must suffer from lack of freshness and variety before the pupils have proceeded very far.

There is little that we can commend in the geometry of Mr. Boulton. The author attempts to cover too much ground in the comparatively small space available, so that nothing is very satisfactorily accomplished.

OUR BOOK SHELF.

Ansichten und Gespräche über die individuelle und specifische Gestaltung in der Natur. By Franz Krašan. Pp. vii+280. (Leipzig: Engelmann, 1903.) Price 6s. net.

This quaint but very serious book is an expression of the author's attempts to reach some clearness in regard to the conceptions of species, variety, breed, &c., which he has had to deal with in the course of his botanical studies. He discusses the profoundest questions of biology:—How far is organic form a function of organic substance? What is the nature of reaction to surroundings? Can one distinguish between the original and the accessory characters of individuals? What is the real meaning of metamorphosis and substitution of organs? What is the evolutionary import of variation and mutation and modification? How are we to define species, variety, and breed? What is the scope of hybridisation and in-breeding, of isolation and selection? In short, Franz Krašan traverses the whole field of evolution-theory. And yet the result, to our mind at least, is deplorable—nothing short of a pathetic waste of careful and assiduous thinking, for he has cast his book in the form of dialogues between Arthur, Erwin, Fritz, Julius, Raimund, Walther, and possibly some others whose acquaintance we have not been able to make! They are most honourable gentlemen, with a facility of discourse and a knowledge of biology that make one blush; they bid one another a most courteous "Auf Wiedersehen" after discussing "System und Phylogenie," or the Hieraciums of Central Europe; they reappear cheerful and cocksure, like Job's friends, to reiterate their various convictions, while the reader undevoutly wishes that they would all die off and leave Franz Krašan to tell us in plain German what he really means.

We are told that the "sachkundige Leser," which we had mistakenly assumed to mean ourselves, should have no difficulty in appreciating the incognitos of Arthur, Erwin, Fritz, and Company, but there are puzzles enough in nature without making more in biological literature, and we "give it up." Not, however, without saying that the author has the results of much careful work and thought to communicate, the pity being simply that he has hidden his light under the bushel of a method of presentation which is anachronistic, repellant and absurd. We hope that he will feel himself impelled to part company with Arthur, Erwin, Fritz, &c., and tell us in a short essay what he really thinks about individual and specific characters as these occur in nature.

J. A. T.

Vegetationsbilder. By Dr. G. Karsten and Dr. H. Schenck. Plates 48. (Jena: Gustav Fischer, 1903.)

Botanists have been distinctly tardy in taking advantage of the facilities offered for introducing photographic illustration into descriptive books. Some American elementary text-books contain very excellent flower studies and ecological scenes, but practically the only standard work in which full advantage has been taken of photographic reproduction is Schimper's "Pflanzengeographie," in which the epoch-making physiological treatise is embellished with magnificent illustrations.

It may be assumed that the success of Schimper's book prompted the publication of this work, in which the illustrations form the main feature, and the text is added by way of explanation and comment. The work has been issued in eight parts, each of which may be purchased separately, and each part contains six plates illustrative of a particular region or representing plants associated by common characters. Three parts deal with tropical lands in which moisture-loving plants abound, and these contain illustrations of rain-forests in Mexico, Java, and Brazil. The superabundance of vegetation does not lend itself well to photography, but the extraordinary development of climbing aroids and epiphytes is well shown. Another conspicuous feature of these regions is the prevalence of large-leaved plants—species of Heliconia, Calathea, Begonia, and many belonging to the order Melastomaceæ—which constitute the ground vegetation. Owing to the more obvious characteristics and the reduced number of plants growing in dry or exposed situations, the photographs of South African scenes, of the seashore vegetation of Brazil, and of Mexican types are the most successful. Of the general character sketches, interest attaches to that showing the growth of *Ipomoea pes-caprae*, but quite the most striking is the illustration of the spread of the sedge

plant *Remirea maritima* and the grass *Stenotaphrum americanum*. Many of the illustrations are limited to the study of a single tree or shrub, indeed all in the parts which deal with monocotyledonous trees and economic plants.

The editors, Drs. G. Karsten and H. Schenck, have provided a very useful and instructive series of plant studies, and it is to be hoped that the publishers will be encouraged to arrange further series. To the botanist and plant lover, as well as to the student, these carefully prepared illustrations should be of very great interest, and will help to make more definite the written descriptions of travellers.

Photographic Failures. Prevention and Cure. By "Scrutator." Pp. 94. (London: Published for the *Photogram* by Dawbarn and Ward, Ltd., 1903.) Price 1s. net.

The subject of this book will appeal to numerous photographers, for many are the pitfalls which they try to avoid.

Negatives may be too hard or too dense, thin, fogged, unsharp, spotted, curiously marked, &c., and prints may suffer from many similar blemishes.

A book that will inform the photographer of the remedies that may be applied to the particular fault in question is one that should be thoroughly welcomed.

"Scrutator," of the *Photogram*, seems to have supplied this want, and confines his antidotes to the problems which beset the practical photographer. The method of treatment adopted is to describe each failure, fault or defect, then to state the causes to which they are due, and finally to suggest either the preventatives or the remedies to be employed. In the case of negatives he gives some specimen negative prints on thin transparent paper to show how incorrect exposure and development affect the relative tones. The book is one that will be very useful to every photographer.

Up-to-Date Tables for Use throughout the Empire. Weights, Measures, Coinage. Compiled and written by Alfred J. Martin. Pp. 251. (London: T. Fisher Unwin, 1904.) Price 2s. 6d.

The compiler of this collection of tables believes that the adoption of the metric system of weights and measures for use within the Empire is near at hand, and it is to be hoped his optimism will be justified. He maintains "that if the metric system were made compulsory for railway companies; were adopted by the Bank of England; and shown on our Ordnance Surveys; that within a very short time the system would be generally adopted throughout the Empire." It is unnecessary to do more than mention a few of the numerous tables provided. There are tables showing the relations of various weights and measures of water and of its density at different temperatures; a comparison of British and international systems of physical units, and of measures of time. The little book should certainly serve to popularise the decimal system. A penny supplement for beginners, intended as a guide to simple arithmetic and to show how decimals can be taught at an early age, is also published.

Arithmetical Examples. By W. G. Borchardt, M.A., B.Sc. Pp. viii+279. (London: Rivingtons, 1903.) Price 3s.

These examples, with the exception of one paper, are taken from the author's "Arithmetical Types and Examples" recently noticed in these columns. The exercises are numerous and well graded, and in drawing them up Mr. Borchardt has kept the recommendations of the Mathematical Association Committee before him.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* Nature. *No notice is taken of anonymous communications.*]

Röntgen Rays and the γ Rays from Radium.

It has been proved by Mr. Strutt that, for the γ rays of radium, the relative conductivity of gases varies approximately as the density, whereas there is a wide divergence from this law in the case of Röntgen rays. Taking air as the standard, the figures given are:—

	Density	γ Rays	Röntgen Rays
Air	1·00	1·00	1·00
Carbon dioxide	1·53	1·53	1·60
Sulphur dioxide	2·19	2·13	7·97
Chloroform	4·32	4·88	31·9
Methyl iodide	5·05	4·80	72·0

Prof. Rutherford suggested some comparative experiments to ascertain if the more penetrating Röntgen rays, after passing through thick metal screens, were similar in their action to the γ rays of radium. The experiments have proved that the relative conductivity imparted to gases by Röntgen rays is a function of the penetrating power of the rays employed, and the results obtained approximate to those found for the γ rays rather than to the high figures previously quoted for Röntgen rays.

In the experiments, two electroscopes were placed side by side, completely enclosed in two thin lead vessels the sides of which were 1·8 mm. thick. A large "hard" bulb and a powerful induction coil were used. The rates of discharge for air were ascertained to be identical, and one of the electroscopes was then filled with gas under examination, and the rates were again measured.

In the case of sulphuretted hydrogen, for which a ratio of six to one has been obtained for ordinary Röntgen rays, the present experiments for penetrating rays showed a close equality with air. This is in agreement with the relative conductivity obtained for the γ rays. Results of a similar character have been obtained for chlorine and for air saturated with chloroform. Further experiments are in progress to compare the relative conductivity of a number of gases for the two kinds of rays.

The results so far obtained indicate that the differences in the relative conductivity of gases, previously observed for Röntgen and γ rays, were due to the great difference in the penetrating power of the rays in the two cases, and that, for Röntgen rays comparable in penetrating power with the γ rays, these differences to a large extent disappear.

A. S. Eve.

McGill University, Montreal, February 18.

Nature of the γ Rays from Radium.

The interesting results recorded by Mr. Eve in the preceding letter on the relative conductivity of gases for very penetrating Röntgen rays removes the strongest objection that has been urged against the common belief that the γ rays are an extremely penetrating type of Röntgen rays. All the experimental evidence so far obtained is now in agreement with the view that the γ rays are very penetrating Röntgen rays which have their source in the atom of the radio-active substance at the moment of the expulsion of the β or kathodic particle. For example, I have found that the γ rays from radium always accompany the β rays, and are always proportional in amount to them. In radium the β and γ rays appear only in the third change occurring in the radio-active matter which causes "excited activity," *i.e.* in the fourth of the chain of radio-active products which result from the disintegration of the radium atom.

In addition, as Mr. Ashworth pointed out in a recent letter to this Journal (January 28), the fact that the amount of γ rays from radium is independent of its degree of concentration points to the conclusion that the γ rays arise from the disintegrated atom, and are not secondary rays set up by the bombardment of the radium as a whole by the β rays.

On the theory of the nature of Röntgen rays, developed

by the late Sir George Stokes and Prof. J. J. Thomson, it is to be expected that Röntgen rays would be set up at the sudden starting as well as at the sudden stopping of the electron or β particle. As a result of the sudden expulsion of the β particle from radium, it is to be expected that a narrow electromagnetic pulse, *i.e.* a "hard" or penetrating type of Röntgen rays, would be generated. In addition, on account of the great speed of the β particle, it is able to penetrate through a considerable thickness of matter before it is stopped. A broad pulse or "soft" Röntgen rays should thus arise at the point of incidence of the β rays.

E. RUTHERFORD.

McGill University, Montreal, February 18.

Learned Societies.

MY attention has recently been directed to the letters of Messrs. Buchanan and Heaviside, and I quite agree that the existing system of referring papers by learned societies is capable of great improvement. But what I wish to point out is that every author who feels aggrieved has a remedy in his own hands, which consists in abstaining for the future from sending papers for publication to the society against which he has cause of complaint.

A sufficient supply of papers for publication in their *Transactions* or *Proceedings* constitutes the life-blood of the societies to which I refer, and if the supply were cut off these societies would soon die of inanition. At the present day there are a large number of mathematico-physical periodicals, most of which supply authors with a reasonable number of *gratuitous* copies of their paper for private distribution, so that authors gain the same advantages which learned societies offer them, without being subjected to the disadvantage of having their papers referred to a *secret inquisition* composed of persons whom I can testify, from personal experience as a former councillor of a learned society, frequently know far less about the subject-matter of the paper than the author does, and whose reports, to my own personal knowledge, have frequently contained errors from not understanding the papers.

There is absolutely no reason why authors should employ learned societies as the medium for the publication of their papers, and if they have a legitimate cause of complaint against any particular society, the practical and common sense course to pursue is to boycott it. If this were done, it would soon be possible to start a "British Journal of Mathematics and Physics" on the same lines as the American and various other foreign journals, the absence of which constitutes a very serious blot upon British scientific enterprise.

A. B. BASSET.

Grand Hotel, Alassio, Italy, March 3.

A Dynamical System illustrating the Spectrum Lines and the Phenomena of Radio-activity.

IN NATURE of February 25 there appeared a letter by Prof. Nagaoka, of Tokyo, relative to the stability and vibrations of a ring of negative electric charges revolving about a central positive charge. Prof. Nagaoka states that such a system is generally stable, but as the result of an investigation by the method used by Maxwell for Saturn's ring, I came to the conclusion some five years ago that the system is unstable if the law of electric force be that of the inverse square and the magnetic force be neglected. Consequently I thought the result not worth publication, but in view of Prof. Nagaoka's letter it may now be of interest to your readers.

Maxwell ("Collected Papers," vol. i. p. 315) finds the frequency equation for displacements perpendicular to the plane of a ring of revolving satellites to be

$$n'^2 = S + (R/\mu)\,J,$$

where S is the mass of Saturn, R/μ that of each satellite, and the radius of the ring is unity. The displacements are of the type $\zeta = C\cos(m\theta + n't + \gamma)$, where C, γ are arbitrary constants, θ is the arc from a point of the ring to the satellite, and m is an integer.

If p be the number of satellites and r an integer, we have

$$J = \Sigma \sin^2 m\theta/2 \sin^3 \theta$$

with $\theta = r\pi/p$; the summation is taken for all values of r from 1 to $p-1/2$ if r be odd, and from r to $p/2$ if p be even, with the coefficient $\frac{1}{4}$ for the last term in place of $\frac{1}{2}$. The disturbance which is most likely to cause instability is that for which $m = p - 1/2$, or $p/2$, as the case may be.

In the electrical problem R/μ is to be replaced by $-e^2/Ma^3$, if e be the charge and M the mass of each electron of the ring of radius a; the minus sign is due to the fact that the electrons repel each other. S is to be replaced by $+qe^2/Ma^3$, if the central positive charge be qe. The frequency equation now is

$$n'^2 = (e^2/Ma^3)(q - J).$$

In the same way the angular velocity ω is given by the equation

$$\omega^2 = (e^2/Ma^3)(q - K),$$

where

$$K = \Sigma\ 1/2 \sin\theta.$$

Steady motion is possible so long as $q > K$; this motion is stable (for these disturbances) if $q > J$.

All the terms of K and J are positive, and the lower terms, due to charges near the one considered, increase very rapidly as p increases. Ultimately K is of order $p \log p$, and J of order $p^3 \log p$. The first few values are as follows:—

p	2	3	4	5	6	7	8	9	10
J	0·25	0·58	1·16	2·24	5·0	6·4	11·2	13·6	21·2

I find that $K > p$ when $p > 472$ about; obviously $J > p$ when $p > 7$.

For an electrically neutral system it follows that $p < 8$.

Prof. Nagaoka considers the motion to be quasi-stable; let us therefore consider the value of n' when $p = 8$. In this case $K = 2{\cdot}80$. Thus $\omega^2 = (e^2/ma^3) \times 5{\cdot}2$, and $n'^2 = -\omega^2 \times 3{\cdot}2/5{\cdot}2$, $n' = \sqrt{-1}\,\omega \times 0{\cdot}78$. The time in which the disturbance is multiplied $\epsilon^{2\pi}$ times, that is, 535 times, is thus $1{\cdot}27 \times$ the period of revolution; this implies a high degree of instability for $p = 8$, and *a fortiori* for $p > 8$.

Let us now consider the radial and tangential disturbances; let their frequency be $x\omega$. The frequency equation is of the form

$$(x^2 - a)^2 = b - cx,$$

where a is a positive constant, and $b > a^2$; c is smaller than either, and, in fact, vanishes when $m = p/2$. In the Saturn problem b can be made less than a^2 by making the number of satellites small enough, but in the electrical problem this cannot be done.

Since $b = 0$ for $m = p/2$, all arrangements of an even number of electrons in a ring are unstable; this excludes $p = 2$, 4 and 6.

When $m = (p-1)/2$, I find for

$p=3$:	$a = 0{\cdot}44$,	$b = 1{\cdot}23$,	$c = 0{\cdot}24$;
5:	0·55,	3·80,	0·47;
7:	0·85,	10·80,	0·66.

The parabolas

$$y = x^2 - a \quad \text{and} \quad y = b - cx$$

in these cases intersect in only two points; thus two frequencies are imaginary, and the system is unstable.

Of course, the whole investigation assumes symmetrical arrangement of the electrons. When there are three rings the frequency equations involve toroidal functions and are difficult to deal with. The effect of magnetic force has not been taken into account, but I do not see any reason why it should seriously affect the conclusions.

G. A. SCHOTT.

University College of Wales, Aberystwyth, February 29.

P.S.—I am at present examining the case of three or more rings; the axial motion for three rings can be made stable by taking the radii nearly equal and the electrons of the middle ring of opposite sign to those of the other two; as to the radial and tangential motions, I am not yet able to express an opinion. Two rings are obviously unstable.

March 7.

The n-Rays.

IN trying to repeat Blondlot's experiments I have met with the usual lack of success, but one experiment I have made seems worthy of record. A small quantity of radium salt was accidentally spilled upon a barium platinocyanide screen, which consequently became faintly luminous in the dark. The light was very faint, and in order to see it more

clearly I placed the screen nearly in contact with the eye. On touching the back of the screen with the finger, just under the luminous patch, there was seen to be a perceptible alteration in intensity of the light.

On pressing the screen with the finger the light seemed to become less intense, and on removing the pressure the intensity was restored. A piece of metal, whether cold or hot, produced the same effect as the finger, and therefore vital action is not necessary for the phenomenon.

At first sight it seemed as though the effect was caused by the muscular effort of the observer, for pressing the back of the head against a wall whilst the screen was in contact with the eye apparently made some difference in the brightness of the light, as also did clenching the hands, but in some cases the light was brighter and in others fainter, so that not much reliance can be placed upon the observation. Another person's hand was as efficacious as that of the observer.

I tried the experiment on two other persons without telling them what was to be observed, and in both cases they said "the light is fading."

The experiment is very easily repeated, and it might be interesting to know whether it can be seen more readily than the *n*-ray manifestation. The screen must not be very bright; a zinc sulphide screen does not answer at all.

W. A. DOUGLAS RUDGE.

Woodbridge School, Suffolk.

Earth Structure.

PROF. MILNE, in reviewing Mr. T. Mellard Reade's book, "The Evolution of Earth Structure, with a Theory of Geomorphic Changes," emphasises the demand at the present time for some theory which shall explain "pulsatory movements by which large tracts have been alternately raised and lowered." Mr. Reade has attempted to supply the want, but, as Prof. Milne points out, his explanation is in some respects not very fundamental.

Just before any solidification had occurred, the hot viscous gases which originally composed our earth, under the combined influence of gravity and diffusion, arranged themselves in such a way, each according to its density, that the heaviest swarmed towards the centre, where the pressure was also highest, and diminished in concentration towards the outside, where the pressure was at the same time lowest. In this way an infinite number of layers would have been formed, in which the change of composition varied gradually but continuously from the centre to the outside, and the total composition at depths far apart was widely different. When such a mass goes on cooling, where will solidification take place?

The temperature of the earth's centre is probably much higher than the critical temperatures of substances with which we are acquainted, and such substances would therefore be gaseous there. Possible exceptions are the platinum metals, a few other elements, and *endothermic* compounds. The latter are quite stable and almost certainly easily formed at these temperatures and pressures, and they can also most probably remain solid at enormously high temperatures. If so, it is obvious that solidification in the mass of the earth's gases would have very soon occurred, not merely on the outside, where the temperature gradient was always very steep, but at some one or more, possibly deeply situated places where the layers happened to be of a composition more suitable in the circumstances, for the making of infusible endothermic substances to us probably unknown—than those nearer the outside. There would then be layers of fluid sandwiched in between layers of solid. If we suppose the temperature coefficient of expansion in these localities to be similar to those met with on the earth's surface, any particular solid layer there would, as the whole earth cools, contract more quickly than the layers underneath it, until the solid would at length give way, and an escape of magma through the rupture would relieve the tension. All the layers above, including the outer crust, would respond to this explosion; but in time the customary steady rate of cooling and contraction would be resumed, which ultimately leading up to another "blow off," would culminate in the continued repetition of the whole process.

Endothermic compounds can store enormous quantities of internal energy, which in suitable circumstances offering conditions of less stability can be discharged. The simple rupture would therefore be complicated by the production of chemical changes, by expansion and contraction locally, and possibly even by regelation. If in the earth's interior the coefficient of expansion increases with the temperature or with the pressure, there would be a tendency for the centre to shrink away from the layers above, and vesicles would result, as pointed out long ago by Fisher. As these vesicles would get larger and larger, a solid layer anywhere here would be subjected to a strain as a result of the differential motion above and below it, and a collapse—obviously tending to become recurrent—would occur, which would ultimately affect the outer crust periodically or spasmodically.

It is tolerably certain that under oceans the outer crust is much thicker than it is under the continents; the temperature gradients teach us this, and plumb-line measurements are also probably, most simply so explained. When a movement occurs below, we should consequently expect that the crust would "give" more under the continents than under the oceans. This would in the long run be an agency tending to counteract the effects of denudation, &c., so that continents should rise relatively to the oceans; and though no doubt local conditions could easily modify the easy applicability of this generalisation to any particular case, this seems an eminently useful conclusion.

It is not at once obvious that there is anything, so far, at variance with any of the well-known facts discovered by the labours of Hopkins, Kelvin, Delauney, Darwin, Fisher and others; on the contrary, the joint results of their work seem to require a combination of solid and fluid which here appears to find adequate satisfaction. When it is so generally assumed that the first portion of the earth to solidify was the outermost part, it is, perhaps, not unnecessary to point out that that is, as a matter of fact, not quite true. In the atmosphere and hydrosphere we have the lightest—and fortuitously the most volatile—of those gases which originally cooled to make our planet. Quite irrespective of what may happen below us, we know for certain that the outside of the earth must cool some 200 degrees before our descendants or their helium-breathing and demon-like representatives will find solid air among the constituents of the rocks under our feet.

Kristiania, February 5. CHARLES J. J. FOX.

Asymmetric Synthesis.

WITHOUT wishing to detract from the ingenuity displayed by Dr. W. Marckwald in his "asymmetric synthesis" of valeric acid, noticed in your issue of February 25, we desire to point out that it is not a true asymmetric synthesis in the ordinary sense.

The ion of the acid or acid salt of ethylmethylmalonic acid may exist in solution in two enantiomorphously related forms

$$\begin{array}{ccc} \text{COOM} & \qquad & \text{COOM} \\ | & & | \\ C_2H_5\text{—}C\text{—}CH_3 & & CH_3\text{—}C\text{—}C_2H_5 \\ | & & | \\ \text{COO}' & & \text{COO}' \end{array}$$

On the addition of brucine the least soluble salt will crystallise out. This is no more than the resolution of an externally compensated ion by Pasteur's well-known method. Both components of the salt will be active. The subsequent decomposition will, if no racemisation occurs, of necessity give rise to an active acid. Now this is a very different thing from the problem attacked by Fischer and Slimmer, Cohen and Whiteley, and Kipping. In these cases the original substance which is to be rendered active is not capable of existing in enantiomorphously related forms until it is submitted to chemical change in combination with the active substance.

It is for this reason that we consider that Dr. Marckwald cannot claim to have accomplished a true asymmetric synthesis.

J. B. COHEN.
T. S. PATTERSON.

The Yorkshire College, Leeds, February 26.

GEOLOGICAL PHOTOGRAPHS.

GEOLOGISTS will welcome the second issue of photographs by the committee of the British Association, appointed for the collection, preservation, and systematic registration of photographs of geological interest. The circumstances which led to the appointment of the committee were fully set forth in our review of the first issue (NATURE, vol. lxvii. p. 32, November, 1902). The value of these illustrations, both for teacher and student, is beyond question; indeed, as furnishing material for comparative study they may not infrequently prove useful to the investigator also; it may not perhaps be regarded in the light of a compliment when it is added that there is at least one university professor who makes them serve for examination purposes, but this is a perhaps too practical inquisitor, who, when weather permits, sets his examinees in front of previously unseen sections in the field. Every student, not to say teacher, of geology should have seen most of the phenomena somewhere or other which these photographs display, but it is very possible that not everyone has; it is even possible that some geologists have not seen a cirque, an esker, and a pitchstone-lava flow, *i.e.* not all three. Nothing, of course, can be a substitute for direct observation, but these photographs are certainly the next best thing to it.

FIG. 1.—Overfolding in Upper Carboniferous Limestone: South of Lough Shinny, Dublin. Photographed by Mr. J. A. Cunningham.

Their value is greatly enhanced by the fact that the descriptions have in each case been entrusted to a specialist familiar with the structure illustrated; we need only refer to Profs. Bonney, Lapworth, Marr, Watts and Garwood, not to mention many other familiar names, to show that the scientific description of scenery has been placed in the best of hands. The subjects chosen for illustration cover a wide range; the Scúr of Eigg, with its old lava flow filling a valley now exalted into a conspicuous hill, is shown from a point of view not often selected, and with excellent effect; the column of the Hemlock stone, very reminiscent of the Sahara, offers an admirable illustration of wind abrasion, though it is said to have been at one time mistaken for a sea-stack; a cirque in Bala rocks is interesting both in itself and on account of the associated glacial and fluviatile phenomena; the Cheddar ravine is a good example of an unroofed subterranean stream; and a boulder of Silurian rock resting on a glacially polished pedestal of mountain limestone affords a proof of the comparatively trivial amount of subaërial denudation which has taken place since the close of the Glacial period; the cliffs of Muckross are an excellent study in jointing, here, as sharply shown as in a text-book diagram; the raised beach at Saunton Down End, near Barnstaple, is probably one of the finest examples of such beaches to be found in the British Isles; the classic unconformity of Old Red Sandstone on Silurian rocks at Siccar Point, referred to by many of the old masters and figured by Lyell in his "Elements," is well described by Prof. Lapworth; there is a good example of metamorphism produced by the great Whin sill; the rumbling hole in the ravine, Glenariff, co. Antrim, is a triumph of the photographer's skill.

From so much excellent material (the series comprises twenty-four photographs) it is difficult to choose, but with the kind permission of the photographers we select two examples for reproduction on a reduced scale, which may be taken as fair specimens of the

FIG. 2.—Stems of *Lepidodendron Veltheimianum*, Sternb., *in situ*: Victoria Park, near Partick, Glasgow. Photographed by Mr. J. R. Stewart.

whole. The overfolded mountain limestone of Fig. 1, covered by Boulder-clay, presents many points of interest; the duplication of the fold, just behind the figure in the foreground, is particularly well shown, and the various behaviour of the beds in the anticlinal to the right is most instructive, as is the onion-shaped synclinal, which succeeds it. The second figure illustrates part of an ancient Carboniferous forest which extends over a considerable area around Glasgow, and is not seldom exposed by quarrying operations. The trunks of the trees are rooted in dark coloured carbonaceous shales, and covered with grey sandy shales and flaggy sandstones, in which their débris—branches and fragments of bark—lies scattered; overlying the whole is a sill of intrusive dolerite (unfortunately quarried away, and so not shown in the figure), to which possibly they owe their preservation. It is very gratifying to know that steps have been taken to protect this interesting exposure from the weather by roofing it over, though the scene must thereby lose some of the picturesqueness suggested by the photograph, where the contrast of the graceful living trees with the stumps of the extinct and monstrous Cryptogams (one of these measures 3 feet in diameter) has a very pleasing effect.

The committee is to be congratulated upon the great and general excellence of the work, and the editor of the series for the admirable judgment he has displayed in making a selection from the vast amount of material at his disposal.

ACTION OF ANÆSTHETICS ON PLANTS.

It not unfrequently happens that the passer-by in autumn is startled to find horse-chestnuts and other spring-flowering trees producing a second crop of flowers. A similar occurrence is not infrequent in pear or apple trees and in the common laburnum. This autumnal flowering is due to one of two causes. In some cases after the flowers have been produced on the "old wood" or on short "spurs," the *Kurztriebe* of the Germans, formed in the previous autumn, other flowers are produced on the long shoots of the present year. The difference in the general appearance of a tree producing its flowers on the "spurs" and of one where the blossoms are produced on the "extension shoots" is often greater than that observable between distinct species, and yet, of course, there is no specific difference between them. The autumnal production of flowers on the yearling shoots is generally assigned, but in a vague, indeterminate fashion, to changes in external conditions. Be that as it may, there are some varieties such as the Napoleon pear which every year behave in this fashion. The operations of pruning are regulated by the way in which the buds are produced on the old or on the new wood of the year, so that the gardener has to take cognisance of appearances which might be, and indeed are, generally ignored by the systematic botanist.

Another cause of autumnal flowering is due to precocity or anticipation. This is the matter which in particular has suggested this note. The flower buds are formed in their usual place, but, for some reason or other, growth and development are hastened, and the flowers which in ordinary circumstances should unfold in the following spring are seen to expand in autumn.

In one of the squares in Paris last autumn the whole or the greater part of the horse-chestnut trees were in bloom, young foliage being interspersed among the flowers. On closer examination it was seen that the older leaves had almost all fallen prematurely or were shrivelled up as if the roots had been deprived in some way of their necessary supplies of water. Similar instances of autumn flowering are familiar to observers, and they seem generally to be due to summer drought, to removal at an unpropitious period, or to any cause which interferes with the normal course of nutrition. Allusion is made to these phenomena because they throw light on the experiments of Johannsen, of Copenhagen, who was the first to show the effect of ether vapour in hastening the flowering period of various shrubs. The action of the vapour of chloroform and that of ether in arresting the movements of the leaflets of the sensitive plant (mimosa) have long been known, but the action has been considered to be purely local.

Matters were in this state when Johannsen pushed his experiments further, and in a different direction, and proved that the flowering of lilacs could be hastened by exposure to the vapour of ether. He thought that if he shortened the resting stage of the shrubs during which their activity is dormant, he would be enabled to induce the earlier and more rapid production of flowers. Exposure to the vapour of ether he found arrested the growth of the plant and secured its earlier and more complete "rest." Johannsen's experiments have been repeated on a large scale in Germany and in France, the general method of procedure being the following. In a case, as nearly air-tight as possible, the lilac bushes are placed at a temperature of about 65° F. Light is excluded. From the top of the case is suspended a small cup into which the ether is poured by means of a funnel through an aperture, made for the purpose, and immediately closed. Owing to the explosive nature of the vapour the greatest care must be taken to avoid the presence of any flame. Thirty or forty grammes of ether are enough for a hundred cubic litres of air. The plants are subjected to the influence of the vapour for forty-eight hours. On their removal from the ether chamber the leaves fall, if they have not already done so. The plants are then removed to a cool house and gradually subjected to forcing in the ordinary manner.

By these means the expansion of the blooms is hastened, the etherised plants producing their blooms several days before those treated in the ordinary manner. The gain of a few days is a matter of great importance to the grower for market in the winter season, as he gets so much better a price for his goods. Moreover, the cost of fuel is reduced, for the same amount of heat is not required for forcing, as we have seen that the time required is diminished. Not only lilacs, but many other flowering shrubs have been experimented upon, and with such good results that the process has been adopted on a large scale, and in our own country Mr. Jannoch has, we learn, adopted the plan with most successful results.

A writer in the *Jardin* of January 20 narrates how he exposed plants of lilacs to the vapour of ether in the manner above described on December 7, removed them to the greenhouse on December 9, and on January 1 the flowers were sufficiently expanded for use in the decoration of his apartments. Other varieties followed at a few days' interval. *Spiraea Thunbergii* etherised on December 7 was in full bloom on December 24.

M. Minier, who made these experiments, placed his apparatus in a temperature of 13°–16° C., and the plants were subjected to the ether vapour for forty hours. They were afterwards placed in a house where the temperature ranged from 13°–16° C. at night to 15°–18° C. by day.

The photographs showing the contrast between the etherised and the non-etherised plants are very remarkable and bear witness to the value of the process in securing bloom in the dull season when the chrysanthemums are beginning to go off. It is noteworthy

that the operation is most successful in November and December, and that if delayed until January the results are not so serviceable, as flowering plants can then be obtained in the ordinary way.

It is surmised that the anæsthetics act by causing the removal of the water from the protoplasm, thus drying it up to a certain extent and causing a suspension of its activity. Dr. Johannsen's observations are summarised in a *brochure* published in French by M. Maumené, and entitled "Nouvelle méthode de culture forçée des arbustes et des plantes soumis à l'action de l'éther et du chloroforme," Paris 1903. Abstracts from these publications have been given in various Continental and English horticultural journals, particularly in the October part of the *Journal* of the Royal Horticultural Society, which contains a paper on the subject by M. E. Lemoine, of Nancy, to which reference may be made for fuller details.

M. O. CALLANDREAU.

IT is but a short time since one read in the *Bulletin Astronomique* the words of generous appreciation and sympathy with which M. Callandreau committed to the grave the remains of his friend and colleague M. Prosper Henry. There was no suspicion then that in a very short time his own funeral oration would have to be spoken, or that the staff of the Paris Observatory was so soon to suffer another almost irreparable loss by the removal of another zealous officer equally renowned, equally devoted to the interests of the observatory, but adding to its reputation in a very different direction.

For many years attached to the service of the observatory, M. Callandreau took part in the routine observations, more especially confining himself to the extra-meridional work. Small planets, comets, double stars, each in turn came under his notice, but though a skilful and painstaking observer, he will not be remembered for his diligence in this direction.

Trained in a school directed by profound mathematicians, in which, perhaps, the influence of Gylden can be recognised, and gifted with an unusual analytical skill, he attacked nearly all the questions of celestial mechanics, and everywhere left traces of his powerful and inventive mind. His acquaintance with all the resources of analysis as applied to the practical needs of astronomy enabled him not only to improve the methods employed in some of the more recondite applications of mathematics to astronomical problems, but induced him to open up new paths of inquiry, which are likely to exercise no inconsiderable influence on many questions of abiding interest and prime importance. It will be sufficient here to refer to his method of treatment of definite integrals which occur in the calculations of planetary perturbation, to the consideration he gave to the troublesome question of perturbations of small planets in which the mean motion is nearly commensurable with that of Jupiter, to his occasional references to the theory of the moon, to the figures of the planets, to problems in geodesy, to show how wide an outlook he possessed over the necessities and the difficulties of mathematical astronomy. It is perhaps in some measure to be regretted that his attention wandered over a variety of inquiries, for if everywhere he illuminated the subject under discussion, greater concentration in a particular subject might have added to his reputation and left a deeper mark on the history of his time. Perhaps his "Contributions to the Theory of Cometary Capture" comes nearest to a complete treatise, and his services in this department of astronomy will be long remembered. Some of his papers bear marks of being suggested by his professorial work in connection with the École Polytechnique, where he occupied the chair of astronomy. His life was a busy one, divided between his duties at the observatory and his professorial engagements, while his kindness of disposition induced him to give willing assistance to those who applied to him. The writer of these few lines gratefully acknowledges more than one kindness he has received at the hands of this distinguished mathematician and astronomer.

Member of the Paris Academy of Sciences and honoured in his own country and among his colleagues, we look in vain for his name among the foreign associates of the Royal Astronomical Society. The kind of work on which he concentrated his attention does not appeal to a numerous class of astronomers, especially would it fail to collect the suffrages of amateurs. But those who read his numerous papers will admit the ability by which they are distinguished and the informing character of their contents. We extend a respectful sympathy to the institution that is bereft of his services, to his colleagues who lose an illustrious example, and to his pupils who are deprived of an able and encouraging teacher. W. E. P.

NOTES.

AN important step has been taken by the Colonial Office, in conjunction with the Imperial Institute, in giving expert assistance to a project of the British Cotton-Growing Association to start cotton growing on a large scale in southern Nigeria. A detailed examination is to be made of several promising districts in the Protectorate, in order to determine the suitability of the soil, climate, &c., for planting cotton, the most important of these districts being the Sobo plains near the coast, where the Ethiope and Jamieson Rivers enter the sea. Mr. W. G. Freeman, of the scientific staff of the Imperial Institute, formerly of the Department of Agriculture of the West Indies, has just left England under instructions from the Colonial Office to cooperate in this matter with Mr. P. Hitchens, the local forestry officer in southern Nigeria, whose services have been placed at the disposal of the British Cotton-Growing Association by the local Government. In the event of a favourable decision being arrived at, the Colonial Office intends to render every assistance to the British Cotton-Growing Association in organising the arrangements for cotton cultivation in southern Nigeria, which will be commenced this season, and on the results of these preliminary operations the extension of cotton cultivation in the Protectorate will depend.

AFTER practically fifty years' connection with the Berlin Observatory, Prof. Förster proposes to retire from the directorship, to which he succeeded on the retirement of Encke. The knowledge that he can survey a long period of activity and of successful work, and that he carries with him the hearty appreciation of his colleagues, will be to him a source of satisfaction in his well merited retirement and leisure. The observatory that he leaves to his successor and the problems that engage attention now are different from those that he took over from Encke. It would be interesting to compare the present state of the observatory and its instrumental equipment with the condition in which Prof. Förster found them when he joined the staff. In those ancient days the work of the observatory was to some extent hampered by the preparation of the national ephemeris, which, under the title of "Encke's Astronomisches Jahrbuch," attained such well deserved consideration. Gradually the Rechen Institut has separated itself more and more from the observatory, until the name of the

director is no longer connected with the publication. Further, though the instrumental equipment has been extended, and is no doubt now in a high state of efficiency, yet the new director will probably find that larger telescopes are necessary to enable the observatory to compete with other national observatories. One may look for considerable expansion in this direction under the guidance of an astronomer so well known as Dr. Hermann Struve, who, it is reported, will take up his residence in Berlin next October as the director of the observatory. His reputation, built mainly on his admirable work connected with Saturn's satellites, will have confirmed him in the importance and advantage of instruments possessed of great optical power.

A REVACCINATION Bill, promoted by the Imperial Vaccination League, has been introduced into the House of Commons by Sir John Batty Tuke, and is backed by Sir M. Foster, Sir J. Dorrington, Sir R. C. Jebb, Dr. Thompson, and Dr. Farquharson among others. The Bill provides for the revaccination of all children between the ages of twelve and thirteen, except those who may be exempted in the way prescribed by the Act of 1898, or on medical grounds. A manifesto in support of revaccination at school age has been circulated by the league, and has already received the signatures of a number of influential persons, including the Chief Rabbi, Lord Kelvin, Sir Frederick Pollock, headmasters of public schools, heads of colleges, &c. Mrs. Garrett Anderson, M.D., the honorary secretary of the league, in a letter to the *Times* solicits further signatures, to be addressed to 53 Berners Street, W., and headed "Manifesto in Support of Revaccination," and with the name, address, and style of the sender clearly written.

WITH regard to the article on the "Fish Hypothesis and the Transmission of Leprosy," that appeared in NATURE of February 25, Dr. John Knott writes to point out that leprosy has disappeared from Ireland, though the condition of the people, especially on the west coast, has but little improved, and half decomposed fish is still freely eaten.

A COMMITTEE has been formed with the object of obtaining subscriptions for a memorial to the late Prof. Nicol, in association with the University of Aberdeen, in which he taught for twenty-five years. The form the memorial should take has not been decided, but a suggestion has been made that if a memorial brass, similar to those erected to the memory of his predecessor and his successor, the late Profs. Macgillivray and Nicholson, were provided, and placed with them in the University of Aberdeen, the ornithologist, stratigraphist, and palæontologist who have brought honour to the university would be fittingly remembered in association with the scene and centre of their life work. The following are among the names of members of the committee:—Prof. J. W. Judd, C.B., F.R.S., Dr. J. Horne, F.R.S., Dr. B. W. Peach, F.R.S., Prof. Stephenson, Prof. Trail, F.R.S., and Prof. J. Arthur Thomson. The secretary and treasurer, to whom subscriptions should be sent, is Dr. W. Mackie, 13 North Street, Elgin.

THE French Association for the Advancement of Science has decided, on the proposition of the president, M. Laisant, to endow a course of astronomical physics in connection with the faculty of science of the University of Paris. The professor is to be M. Pierre Puiseux, of the Paris Observatory.

WE regret to see the announcement, in the *Daily Chronicle*, that M. F. A. Fouqué, the eminent French geologist and mineralogist, died in Paris on March 7 in his seventy-sixth year.

A TELEGRAM from Mayotta, one of the Comoro Islands, states that since February 25 a volcanic eruption has been in progress in Comoro. Lava is being thrown up from three craters, situated about 1000 yards distant from one another. It is reported that at Penzance and some of the neighbouring villages an earthquake shock was felt at 1 p.m. on March 3. A telegram received at New York states that an earthquake, more violent than any experienced in that city during the past thirty years, occurred at Lima, the capital of Peru, at 5.20 a.m. on March 4.

THE death is announced of Dr. A. S. Murray, keeper of Greek and Roman antiquities in the British Museum. Dr. Murray was born near Arbroath, in Forfarshire, on January 8, 1841. He was educated at the Royal High School of Edinburgh and Edinburgh University, and was also for some time a student at the University of Berlin. In February, 1867, he was appointed assistant in the department of Greek and Roman antiquities in the British Museum, the then keeper of the department being Mr. (afterwards Sir Charles) Newton. When Newton retired from the keepership in the spring of 1886, Mr. Murray was appointed his successor. Among the unofficial works written by him were a "Manual of Mythology," a "History of Greek Sculpture," a "Handbook of Greek Archæology," and "Sculptures of the Parthenon." Dr. Murray's scientific position was remarkable for the fact that, almost alone among modern archæologists, he refused to accept the evidences for the early dates that are now assigned to the Mycenæan period of Greek antiquity. Dr. Murray was a correspondant of the Institute of France, corresponding member of the Prussian Academy of Sciences, member of the British Academy, fellow of the Society of Antiquaries, and vice-president of the Hellenic Society.

THE Trustees of the Elizabeth Thompson Science Fund made the following grants at a meeting held in Boston, Mass., on February 5:—300 dollars to Prof. Morris W. Travers, London, for researches on the absolute scale of temperature, by experiments with liquid hydrogen; 150 dollars to Prof. Benjamin L. Seawell, Warrensburg, Missouri, for study of the taxonomy and ecology of the organisms of fresh-water lakes, in relation to fish foods and water supplies; 40 dollars to Prof. A. Nicolas, Nancy, France, for studies on the embryology of reptiles; 250 dollars to Prof. H. S. Grindley, Urbana, Ill., for the separation and purification of the nitrogenous substances of meats; 200 dollars to Prof. R. Hürthle, Breslau, Germany, to determine the relation between pressure and the obliteration of circulation; 143 dollars to Prof. W. J. Moenkhaus, Bloomington, Ind., for studies on the individuality of maternal and paternal chromatin in hybrids; 50 dollars to Mr. S. P. Fergusson, Hyde Park, Mass., to measure the errors of absorption hygrometers; 300 dollars to Dr. Werner Rosenthal, Erlangen, Germany, for researches on the Lombardy chicken pest; and 300 dollars to Prof. Henry S. Carhart, Ann Arbor, Michigan, for the preparation and study of Clark and Weston standard cells.

THE twenty-sixth annual general meeting of the Institute of Chemistry was held on March 1, Mr. David Howard, president, being in the chair. Prof. Tilden moved the adoption of the annual report of the council, at the same time commenting on the general progress of the institute. He considered it satisfactory to note that, notwithstanding the increasingly stringent regulations as to training, the very high standard of the examinations, and in spite of the loss of members by death, the number of fellows and associates, viz. 1098, was 251 higher than in 1894. He also referred

to the scheme for the promotion of the better training of technical chemists, now under the consideration of the council. The president delivered his address, in which he commented on the work of the council during the past year, on the present position of the institute, and on the work the council at present has in hand.

It is reported by the *Scientific American* that the U.S. Navy Department will establish a branch naval observatory in Samoa, and that 1600*l*. has been allotted for this purpose.

THE *British Medical Journal* announces that a congress of experimental psychology is to be held at Giessen on April 18–20. Among the organisers of the congress are Profs. Exner (Vienna), Hering (Leipzig), von Kries (Freiburg), Stumpf (Berlin), and Ziehen (Halle).

ON Tuesday next, March 15, Dr. E. A. Wallis Budge will deliver the first of two lectures at the Royal Institution on "The Doctrine of Heaven and Hell in Ancient Egypt and the Books of the Underworld." The Friday evening discourse on March 25 will be delivered by Prof. Dewar on "Liquid Hydrogen Calorimetry."

AT the thanksgiving service at St. Paul's Cathedral for the centenary of the British and Foreign Bible Society on March 6, the Archbishop of Canterbury referred in his sermon to the relation of science and religion. His Grace said, "It was on the strength of Biblical texts that the scheme of Christopher Columbus was condemned by the Spanish junta in 1490 as vain and indefensible. In 1616 Galileo's teaching that the earth moves round the sun was formally censured by the consulting theologians of the holy office, 'because expressly contrary to Holy Scripture.' A generation or two afterwards English students were warned by high authority against the investigations of so true and profound a Christian thinker as Sir Isaac Newton as being 'built on fallible phenomena and advanced by many arbitrary presumptions against evident testimonies of Scripture.' And the lives of Roger Bacon, of Copernicus, of Kepler, and of many more, down even to our own day, and incidents fresh in the recollection of many here, suggest to the thoughtful student of Holy Scripture the imperative need of a reverent and humble-minded caution in our attitude towards every controversy of the kind. We have been oftentimes reminded that it is only the foundation of God that remaineth sure, and on that foundation have been built also the irrefragable conclusions of science. We are not, indeed, required to accept at once every unproven hypothesis, or to mistake for absolute science mere assertions about that which is unknowable. True science and true religion are twin sisters, each studying her own sacred Book of God, and nothing but disaster can arise from the petulant scorn of the one, or from the timidity or the tyrannies of the other."

THE view of an empire as an organism, presented by Sir John Cockburn in a paper on the biology of federation read before the Society of Arts on February 9, shows that scientific principles may with advantage be borne in mind in the consideration of problems in politics and practical sociology. There is a suggestive analogy between biological development and the life processes of political organisations and institutions. Comte thought that a study of the laws of biology was necessary for the proper comprehension of sociology; Herbert Spencer elaborated the numerous points of agreement between the two sciences, and Sir Leslie Stephen referred to the community as a social tissue. Primitive societies may be regarded as analogous to the simple cell; they are full of vitality, but fall an easy prey to more complex and effective organisations. When an offshoot takes place, the daughter organism completely separates itself from the mother, and there is no coordination between the two bodies. On the other hand, remarked Sir John Cockburn, in the many-celled entities the various groups of differentiated, but not wholly detached, cells undertake different duties, enter into definite relations, and become regularly coordinated in the performance of the functions necessary for the common life. The process of evolution is the same, whether it deals with the primordial cell, which by subdivision forms the various tissues and organs which, grouped together, constitute a complex organism, or whether it deals with a primitive homogeneous society, which by division of labour and coordination of effort becomes a civilised community, and by combination with other communities a nation; or whether, on the highest plane of all, it deals with a race which, by colonisation and subsequent cooperation of its several parts, becomes an empire. Sir John Cockburn's paper contains many other instructive instances of natural law in the political world, and provides a strong case for the cultivation of the scientific spirit in all who are concerned with the progress of the State.

IN the February number of the *American Journal of Science* Messrs. Bumstead and Wheeler give the results of an investigation of the radio-active gas found in the soil and in the tap-water at Newhaven, Conn. They establish its identity with the radium emanation by a careful comparison of the rate of decay of its activity and of its rate of diffusion. Mr. E. P. Adams has recently shown that the radio-active gas discovered by Prof. J. J. Thomson has the general characteristics of the radium emanation, and it seems likely that the gas obtained from the soil in various parts of Germany by Messrs. Elster and Geitel owes its activity to the same source. The authors conclude that radium is probably widely diffused in the earth's crust. They were unable to confirm the existence of a radio-active gas obtainable from mercury.

IN the *American Journal of Science* Dr. C. Barus describes a direct micrometric method for the measurement of the diameter of fog particles. A thin plate of glass is covered with a film of oil and held for a certain time horizontally in the fog, and then rotated back into the field of the microscope, where it is screened from further deposition. The particles caught on the oiled surface appear as brilliant round globules, and persist in a saturated atmosphere for many minutes. Some preliminary results of the number of particles per cubic centimetre and of their diameter are given. The former varies from 4×10^{1} to 2.5×10^{5}, and the latter from 4×10^{-4} to 8×10^{-4} cm. In certain cases the diameters of the drops varied between 10^{-3} and 5×10^{-4} cm., all the intermediate sizes being present. The experiments are being proceeded with by means of a photographic method.

THE chief differences observed between the salts of radium and those of actinium can be explained by means of the view that the emanation from actinium disappears in a few seconds, whilst that from radium decays to one-half in four days. In the *Comptes rendus* of February 15 M. Debierne describes a series of experiments made in order to determine the rate of decay of the emanation from actinium. When the ionisation produced by the emanation was used as a criterion of its activity, a uniform rate of decay was observed, the activity diminishing to one-half in 3·9 seconds. On the other hand, the power of exciting induced radio-activity was found to rise (apparently from zero) to a maximum value, but ultimately to decay accord-

ing to the same logarithmic law as in the case of the ionisation to one-half in 3·9 seconds. The rate of decay of the excited activity was also measured, and the half-value was found to be reached in 40 minutes.

A reproduction, in the *Chemical News* of February 19, of Profs. Curie and Dewar's paper on the examination of a sample of gas occluded in radium bromide contains a number of important details not referred to in the French paper recently summarised in these columns. Thus, in the experiments at the Royal Institution in which radium bromide was heated in a quartz tube, the condensable gases are stated to have contained water, bromine, and carbon dioxide in addition to the emanation, whilst the spectrum observed after freezing out the nitrogen was that of hydrogen, and not of nitrogen as stated in the *Comptes rendus*; in such a tube, it is added, it would be impossible to find small amounts of helium by the spectroscope, seeing that a 10 per cent. helium-hydrogen mixture shows nothing but hydrogen. In reference to the subsequent appearance of the helium spectrum in the vacuous quartz tube, it is pointed out that "until the full spectroscopic examination by Deslandres is published no inference can be drawn as to whether or no the amount of helium has gone on increasing in the quartz tube (as it ought to do if it is a true product of the disintegration of radium), and no conclusion drawn as to the presence of other gases and their origin, whether new or old."

An exceedingly interesting summary of the recent work of Profs. Elster and Geitel on the radio-activity of the air and the soil is contained in a recent number of the Geneva *Archives des Sciences*. In order to test whether the radio-activity of the air was inherent or induced from outside, a steel boiler of 23 cubic metres capacity was kept closed during six weeks, and an aluminium wire was then introduced and negatively charged to a potential of 2000 volts; no radio-activity was induced on the wire, and the air, isolated in this way from the rest of the atmosphere, was completely inactive. The radio-activity is attributed to an emanation produced by some radio-active substance in the soil which finds its way into the included air, and thence into the free atmosphere as well as into the water of mineral springs. An attempt was made to isolate the radio-active constituent of a specially active earth from the Italian Alps, and the results obtained were in accordance with the view that the soil contained a trace of radium; the hydrochloric acid extract yielded a barium sulphate precipitate about as active as potassium uranyl sulphate, and a platinum kathode immersed in the solution became permanently (?) radio-active. Further support of this view is found in the fact that the induced activity separated from the air decays at the same rate as that induced by radium salts.

We have received the first part of the "Abhandlungen zur Didaktik und Philosophie der Naturwissenschaft," which are being issued as adjuncts to the *Zeitschrift fur den physikalischen und chemischen Unterricht*. These are intended to be monographs in a more extended form on matters such as those considered in the *Zeitschrift*. The present number, by Herr E. Grimsehl, of Hamburg (who is one of the general editors), is on "Die elektrische Glühlampe im Dienste des physikalischen Unterrichts," and deals, so far as is possible in the sixty pages at disposal, with the numerous uses to which electric glow lamps can be put in physical demonstrations. Many of these uses are probably well known to most lecturers who have had experience in demonstrating to large audiences, but the beginner will be able to pick up a great number of hints from the descriptions given. The apparatus described can all be obtained from the firm of A. Krüss in Hamburg.

The United States Weather Bureau has recently issued a memoir on the climatology of California, prepared under the direction of Prof. W. L. Moore by A. G. McAdie, professor of meteorology. The author points out that the climate of California is controlled by four great factors:—(1) the movements of the areas of high and low barometric pressure; (2) the prevailing drift of the atmosphere from west to east; (3) the proximity of the Pacific Ocean, with a mean annual temperature near the coast line of about 55°; and (4) the exceedingly diversified topography of the country for a distance of 200 miles from the coast inland. To illustrate these leading features, long series of observations at suitably chosen localities have been elaborately discussed in 260 large quarto pages, with 42 diagrams and charts, and furnish a very valuable contribution to meteorological knowledge. The remarkable pictures of fog billows obtained at the Observatory of Mount Tamalpais, and noticed in our columns some time ago, are reproduced in an interesting article on the fog of the district of San Francisco.

We have received a copy of the second part of the *Psychological Bulletin*, which is devoted to the literary section of the *Psychological Review*. It includes the proceedings of the American Psychological and Philosophical Associations.

The volume of the *Proceedings* of the Philadelphia Academy for the current year opens with the first part of a paper by Mr. H. Pilsbry on new Japanese molluscs, this instalment being devoted to gastropods. The number of species described is very large; unfortunately, one of the names—*Conus dormitor*—has long been preoccupied for the well-known shell from the Barton Eocene.

In the *Proceedings* of the South African Philosophical Society, Mr. W. L. Distant describes a number of new South African Tingididæ and other Heteroptera. In a previous paper the author enumerated twenty-six species, distributed in twelve genera as non-Palæarctic species of the African mainland; the present list raises the number of species to forty, and of genera to twenty-one. It may be considered a pity that the author uses the generic name of a common tree, Ulmus, to designate a new genus of insects.

According to its report, the efforts of the Society for the Protection of Birds were mainly devoted during 1903 to securing more effectual protection for the breeding-places and eggs of our rarer birds, to the extension of the competitions in connection with "Bird and Tree Day," and to further exposure of certain alleged frauds in regard to so-called artificial osprey plumes and the suppression of birds' plumage in millinery. The "watchers' fund," started in 1902, not having met with so much support as was expected, limited expenditure on the first item. It is suggested that the endeavour may be made to render both the sale and possession of skins and eggs of rare birds illegal, but this is surely far too drastic a measure to meet with public approval. Most or all of the so-called artificial "ospreys" were found to be real egret plumes.

An excellent portrait of Prof. D. J. Cunningham appears in the report of the Royal Zoological Society of Ireland for the past year. His appointment to the chair of anatomy at Edinburgh has compelled Prof. Cunningham to retire from

the office of president, which he has filled with such conspicuous success for the last seven years, and the society is deeply sensible of the loss it has thereby sustained. The new president is the Lord-Lieutenant, the Earl of Dudley. The purchasing power of the society has been somewhat crippled by two circumstances, namely, the large amount of damage done to the buildings in the gardens by the great storm of February, 1903, and by a falling off in the gate-money. On the other hand, the gifts of large and valuable animals have been unusually numerous, including a young elephant and a young leopard from the Duke and Duchess of Connaught, and a pair of young giraffes from Sir Reginald Wingate.

WE have received from the Smithsonian Institution a batch of papers published in the *Proceedings* of the U.S. Museum. Among these is one, by Mr. G. S. Miller, on bats collected in Cuba, which contains an interesting account of a visit to a bat-cave in the island. Two others, by Mr. H. C. Oberholser, are devoted respectively to the American wrens and great horned owls. In a fourth Messrs. Jordan and Snyder describe and figure two chimæras from Japanese waters, while in a fifth the former writer and Mr. E. C. Starks review the scorpænoid fishes of Japan. Special interest attaches to the account, by Mr. F. A. Lucas, of a new labyrinthodont and a new reptile from the Trias of Arizona, on account of the identification of the former, which is known by the central thoracic shield, with the European genus Metoposaurus (*olim Metopias*), and from the apparent affinity of the latter, which is known from a humerus, and is named Placerias, with the African Pariasaurus.

WE have to acknowledge the receipt of vol. ii. of the third series of the *Anales* of the Buenos Ayres Museum. Dr. Ameghino's article on "diprotodont" Tertiary mammals from Patagonia has already been noticed in our columns. Among the other contents, two articles by Dr. H. von Ihering, the one on "Cretaceous" molluscs and the other on Tertiary brachiopods of Patagonia, are of prime importance. In the former the author, after pointing out what he regards as serious errors in the determinations of previous observers, concludes that strata regarded as Pliocene are really Pleistocene, and others classed as Miocene are truly Pliocene, while the alleged Cretaceous beds are considered to be more probably Eocene. Further observations on the subject, in which it may be hoped that the age of the various mammaliferous horizons will be taken into consideration, are promised. As regards Tertiary brachiopods, the remarkable resemblance between the South American forms and those of New Zealand, coupled with the equally striking difference between the former and their Chilian representatives, justify the opinion that the South American continent was formerly prolonged towards the Antarctic, and for this prolongation the author has suggested the name Archinotis. This Archinotis extended from Patagonia to Kerguelen Island at a comparatively modern (Tertiary) epoch, but if it formed a connection with Africa it must have been quite separated from the Chilian side of South America.

OF the papers which appear in the second part of the last volume of the *Transactions* of the Royal Scottish Arboricultural Society, the description of the Atholl larch plantation by Mr. J. Booth is interesting both from the historical and scientific aspect, and the information concerning the Douglas fir plantation at Taymount refers to a tree of great value which is fairly well suited to our climate. The volume also contains a summary of the principal coniferous timbers which are imported into the country, written by Mr. A. D. Richardson, "Notes for Planters," by Mr. G. V. Macdonald, and other papers.

A COPY of the fourteenth annual report (1903) of the Missouri Botanical Garden has been received. A very fine illustration is given of the *Agave Toneliana*, and another even more interesting photograph figures *Amorphophallus Rivieri* in flower, which is represented growing from a corm in a saucer (Fig. 1). Mr. A. Rehder presents an exhaustive treatise of the genus Lonicera, supplemented with illustrations of new species. He adopts Linné's subdivision into two subgenera, Periclymenum and Chamæcerasus or

FIG 1.—Saucer Gardening—*Amorphophallus Rivieri*.

Xylosteum, and sinks the subgenus Nintooa in the latter. Another interesting section of this subgenus is named Cœloxylosteum, because the free bracts occur concomitantly with a hollow pith in the branches. The increase in the number of species—the total exceeds 150—is due to the large number of specimens recently gathered in China and other parts of Central and East Asia.

PROF. BOVERI is always interesting when he writes on the cell, and the little volume—"Ergebnisse ü. d. Konstitution der chromatischen Substanz des Zellkerns"—just published by Gustav Fischer forms a useful presentation of the author's views as to the permanence of the nuclear chromosomes. Those familiar with the literature will perhaps not find much that is new, but the clearness with

which the main thesis is kept before the reader considerably enhances the interest of what is mainly a summary of recent work contributed by the author and other investigators.

THE report of the Felsted School Scientific Society for the years 1902 and 1903 shows that the masters at Felsted are encouraging scientific observation of biological and other natural phenomena. Papers by members of the society on the birds, butterflies, moths and plants of the school neighbourhood are printed in the report.

WE have received from the Government of India Department of Revenue and Agriculture a copy of "Agricultural Statistics of India for the Years 1897–98 to 1901–02." The statistics were compiled under the supervision of the Director-General of Statistics, and are published in two parts. The first volume deals with British India and the second with the Native States.

MESSRS. LEPPIN AND MASCHE, of Berlin, have sent us a copy of the catalogue of the physical apparatus to be exhibited by them at the forthcoming St. Louis Exhibition. The first part of the catalogue contains particulars of a set of physical apparatus for the elementary schools in Berlin, and the second section instruments suitable for universities, high schools and colleges.

SOME remarkable examples of positive and negative catalysis are given by Dr. Titoff in the *Zeitschrift für physikalische Chemie.* The case studied was the oxidation by dissolved oxygen of sodium sulphite in dilute aqueous solution, a change which was half completed in 10–20 minutes when the water used was distilled from a boiler with an iron still-head and so contained traces of iron, but required 200 minutes with water distilled in a silvered or tinned copper still, and as much as 1500 to 1800 minutes when the purest available water was used. The oxidation is extraordinarily sensitive to the influence of traces of copper, and it is stated that a marked acceleration is produced by N/1,000,000,000,000 $CuSO_4$, or by merely dipping a piece of bright metallic copper into the water during less than a minute. Mannitol even in N/100,000 solution *reduces* the velocity of oxidation by 50 per cent., and tin salts are even more powerful negative catalysts; at a concentration of only N/250,000 the velocity was reduced to 25 per cent. of the normal value, but even then the tin salt, though 150 times as active as the mannitol, is still 20 to 25 times less active than the copper salts.

THE additions to the Zoological Society's Gardens during the past week include two Nisnas Monkeys (*Cercopithecus pyrrhonotus*) from Uganda, presented by Mr. C. R. Hall; a Macaque Monkey (*Macacus cynomolgus*) from India, presented by the Lady Londesborough; two Cheetahs (*Cynaelurus jubatus*), a Beisa Antelope (*Oryx beisa*) from Somaliland, presented by Captain Barnard; a Horned Capuchin (*Cebus apella*) from South America, deposited; three Gold Pheasants (*Thaumalea picta*) from China, received in exchange.

OUR ASTRONOMICAL COLUMN.

RADIAL VELOCITIES OF TWENTY ORION STARS.—Messrs. Frost and Adams, of the Yerkes Observatory, have just published the complete discussion and results of their determination of the radial velocities of twenty stars, all of which have spectra of the Orion type, in one of the *Decennial Publications* (viii.) of the Chicago University.

The spectra were obtained with the Bruce spectrograph attached to the 40-inch refractor, and a self-induction spark between titanium poles was used as the light source of the comparison spectrum in every case.

An analysis of the velocities obtained—which are reduced to the sun—indicates that the Orion stars, as a class, are much more remote than the solar stars, for their *real* radial velocities are much smaller. A classification of thirty-one Orion stars, based on the behaviour of the lines of He, H, Mg, Si, N and O in the region between λ 4300 and λ 4720, is given at the end of the paper.

CATALOGUE OF LONG-PERIOD VARIABLE STARS.—*Circular* No. 74 of the Harvard College Observatory contains a catalogue of 407 variable stars having long periods, published by Prof. Pickering. The positions and photographic magnitudes of some of the sequences of comparison stars for these variables were published in vol. xxxvii. of the Harvard College Observatory *Annals*; others will appear in vol. xlvii. Those sequences not given in either of the two publications mentioned are given in the present *Circular.*

Prof. Pickering expresses the hope that other astronomers will select and publish similar sequences for long-period variables, and that many will regularly observe these objects. He suggests that in using Argelander's method for determining the magnitudes it is quite sufficient to record that the star under observation is brighter than one and less bright than another of two nearly equal comparison stars, for, owing to the errors introduced by personal equations, &c., the estimation by grades is unnecessarily refined. All the comparison stars selected will, so far as possible, be observed photometrically at Harvard in order that the results from various observatories may be reduced to a common scale.

THE LEONID SHOWER OF 1903.—In the current number of the *Observatory* (No. 342) Mr. Denning gives a table of the apparent paths and magnitudes of twenty-six Leonids, six Taurids, and twenty-three other meteors, observed in England between November 14–18 inclusive, all of which were as bright as, or brighter than, Jupiter. In a second table he gives the real paths of nine of these meteors (including five Leonids, two Taurids, one Hydrid, and one Arietid), and then directs attention to the frequent appearance of bright Taurids and Arietids during the November Leonid showers.

M. Fiévez, of Boitsfort, in a communication to the Académie Royale de Belgique (*Bulletin* No. 12, 1903), announces that, during a watch of two hours (12·30 to 2·30) on the morning of November 16, he observed thirty-eight meteors, of which thirty-four were Leonids. In the same *Bulletin* M. Terby states that two other observers, also stationed at Boitsfort, observed thirty-four meteors, of which twenty-eight were Leonids, between 10.5 p.m. on November 15 and 5 a.m. on November 16. The majority of these were of the first magnitude, and they appeared in groups, six of them being seen in six minutes between 1 a.m. and 2 a.m.

THE DISTRIBUTION OF LINES IN BANDED SPECTRA.—At a meeting of the Paris Academy of Sciences held on February 8, M. Deslandres announced the results of his recent researches in connection with the law, announced by him in 1886, concerning the distribution of lines in spectral bands. These results confirm his law of arithmetical progression, but indicate several anomalies in the behaviour of the independent lines in the series.

From a photograph of the negative-pole spectrum of nitrogen he very carefully determined the frequencies of the individual lines in the band at λ 3577, and found that they may be almost exactly represented by the integration of seven series, each obtained by calculation from the formula $N = A(m + p/q)^2 + c$ (where N = the frequency, A and c are constants, m is a whole number, and p and q are small whole numbers), by giving different values to the constants for each series.

Finally, he states the general law, as now confirmed, in the following words:—"In general each band, expressed in number of vibrations, is divisible into series of connected lines, each series being such that the successive intervals are in arithmetical progression. . . ." (*Comptes rendus,* No. 6).

SUN-SPOT VARIATION IN LATITUDE, 1861–1902.

EVERYONE who is acquainted with sun-spot statistics is familiar with the law known as "Spörer's law of sun-spot zones," which was derived after a laborious series of sun-spot observations made by Spörer himself. Previous to this indefatigable worker, Carrington made a series of most valuable observations between the years 1853 and 1861, and it was he who first directed attention to the fact that sun-spots had a general drift towards the equator during a sun-spot cycle. To use his own words, he stated that there was indicated "a great contraction of the limiting parallels between which spots were formed for two years previously to the minimum of 1856, and, soon after this epoch, the apparent commencement of two fresh belts of spots in high latitudes, north and south, which have in subsequent years shown a tendency to coalesce, and ultimately to contract, as before, to extinction."

Discussing these and his own observations, Spörer was led not only to corroborate the deductions made by Carrington, but to formulate more definitely a law of sun-spot circulation, which he stated as follows:—

"Un peu avant le minimum, il n'y a de taches que près de l'equateur solaire, entre $+5°$ et $-5°$. A partir du minimum, les taches, qui avaient depuis longtemps déserté les hautes latitudes, s'y montrent brusquement vers $\pm 30°$. Puis elles se multiplient, un peu partout, a peu près entre ces limites, jusqu'au maximum, mais leur latitude moyenne diminue constamment jusqu'à l'époque du nouveau minimum."

To arrive at this result Spörer made a very complete investigation of the position of every sun-spot that had been observed up to that time in relation to the solar equator. In fact, he brought together all the statistics of the latitudes of sun-spots for each hemisphere, and determined for each period of the sun's rotation the mean heliographic latitude of the spotted area. To indicate the variation from year to year of this mean heliographic latitude he published curves, and the special feature of these was that each commenced in high latitudes about the time of sun-spot minimum, and gradually approached the equator until the epoch of the following minimum, when a new cycle commenced in high latitudes, the two curves overlapping for a short time about the time of sun-spot minimum.

If Spörer's curves be closely examined it will be found that those which pass strictly through the actual points given by observation are of a *wavy* nature, and are sometimes above and below the mean curve from which Spörer deduced his law. In fact, Spörer himself directed attention to this peculiarity, and distinctly remarked on the subsidiary increases of spotted area and a reversion of spots to higher latitudes at times other than at sun-spot minimum. In later times Dr. Braun, of the Kalósca Observatory, pointed out similar anomalies from his own observations made between 1880 and 1884.

From the illustration (Fig. 2) accompanying this article curves B indicate the wavy nature of these mean heliographic curves, and it will be noticed that even up to the present time this peculiarity is a marked feature.

It was with the object of attempting to trace the origin of these variations—variations which indicated that Spörer's law might be only of a very general nature—that a recent investigation was commenced, the results of which were communicated to the Royal Society (February 11).

The method of analysis was to divide the limited region on the sun's surface in which spots appear into strips or zones, in a similar way to that employed in the study of the prominences (NATURE, vol. lxvii. p. 570). As solar prominences appear on any part of the disc, it was sufficient, in order to trace their distribution throughout a year, to divide the sun's surface into nine zones of 10 degrees each. Since, however, spots seldom occur above latitude 40°, the width of the zones had to be considerably diminished. For the present inquiry, it was decided to group the spots into belts 3 degrees wide, for even zones of 5 degrees in width were found to mask many important characteristics.

The necessity for such narrow zones will be seen from the accompanying figure (Fig. 1), in which the yearly distribution of spots is shown for the years 1879–1883, taking zones of 10 degrees, 5 degrees, and 3 degrees in width respectively.

In these curves each broad vertical line corresponds to the solar equator, and the scales to the right and left of each represent the north and south latitudes respectively. The heights of the curves above each horizontal zero line indicate the different amounts of spotted area, and the scales of these are so arranged that the curves are all proportional to the spotted area.

The curves themselves are formed by determining the mean spotted area for each zone, and plotting each value at the point representing the mean latitude of this zone; these points are then all joined together. Thus, in the case of the 0–10° zone, the mean spotted area is plotted at 5°, 10–20° at 15°, &c. The other zone divisions are similarly treated; thus 0–5° is plotted at 2·5°, 0–3° at 1·5°, &c.

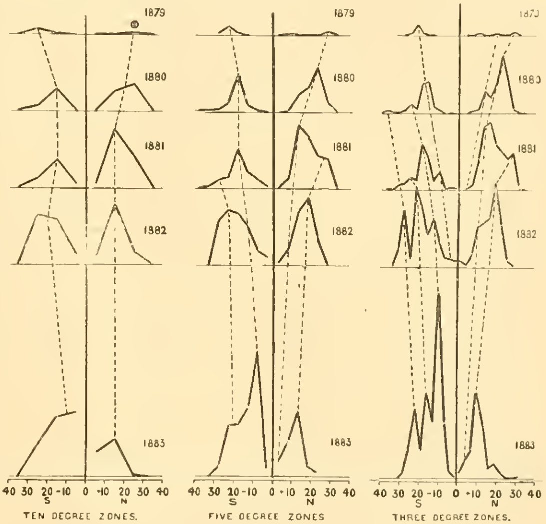


FIG. 1.—Distribution of Sun's Spotted Area.

In the 10° zone curves here shown there is only one maximum in each hemisphere for the years in question, and these, as indicated by the dotted curves which join them, do not progress gradually towards the equator as would probably be the case according to Spörer's law. With 5° zones it is possible to detect the presence of two maxima in one or other of the hemispheres, all of which have a trend towards the equator in succeeding years. Still more detail is displayed in the 3° zones, and here is apparent a spot distribution and movement which is practically masked in the two preceding sets of curves.

The advisability of adopting 3° zones being thus apparent, the whole series of observations from the year 1861–1902 was treated in the above manner, the points plotted, and

the curves drawn as shown in the figure previously referred to.

In this way it was possible to trace the varying positions, as regards changes of latitude, of the centres of action, or maxima points of the curves, from year to year, just as was previously attempted in the case of the prominences. These centres of action were then connected by lines passing from one yearly curve to the next. It is worthy of remark that very little difficulty was met with in deciding the maxima points to be joined. There was always, throughout the whole period, a most distinct march of these points individually towards the equator, and the method of placing the curves one beneath the other rendered such movement at once obvious to the eye.

The diagram (Fig. 1) not only exhibits some of the types of curves met with, but shows how the various centres of maximum spot-activity were joined up with each other, year by year, for the period of time over which the curves extend, namely, from 1879, the year following a sun-spot minimum, to about a sun-spot maximum in 1883.

Considering the curves relating to the sun's northern hemisphere, it will be seen that in 1879, the year following a sun-spot minimum, when the spots were ending a cycle near the equator, two new outbreaks occurred in latitudes about 20° and 30°. These two centres of activity moved towards the equator next year, and by 1881 the former had disappeared, while the other rapidly grew in intensity and reached latitude 15°. During this year a new outbreak in latitude 30° made its appearance, and this in the two following years had an equatorial trend. A somewhat similar occurrence took place in the southern hemisphere, each of the centres of action moving rapidly towards the equator.

It is interesting to note the rapid growth and decay of these centres of action, an example of which is shown commencing in 1879 in latitude 28° in the northern hemisphere. Attention may particularly be directed to the three prominent maxima of the curves for the southern hemisphere in the years 1882 and 1883, which indicate that at this period there were three definite centres of spot action in existence.

To bring the results of the above analysis for the whole period of time investigated within a small compass the same method was adopted as that employed in the case of the prominence reduction to which reference has already been made.

In Fig. 2 the two sets of curves marked A indicate for each hemisphere the changes in the positions of these centres of spot-activity from year to year, plotted at equal intervals of a year. The striped portion is deduced from Spörer's observations, and the remainder from the Greenwich reductions. These lines have been proportionally thickened to indicate approximately the relative amount of spotted area at these centres of action, or, in other words, the heights of the maxima points on the yearly curves. These curves thus indicate for each year the positions, as regards latitude, of the centres of spot activity, and give an idea of the movements of these centres during each sun-spot cycle.

As these curves have here been called "spot-activity tracks," so "prominence-activity tracks" may be employed to indicate the equivalent variations as regards the prominences.

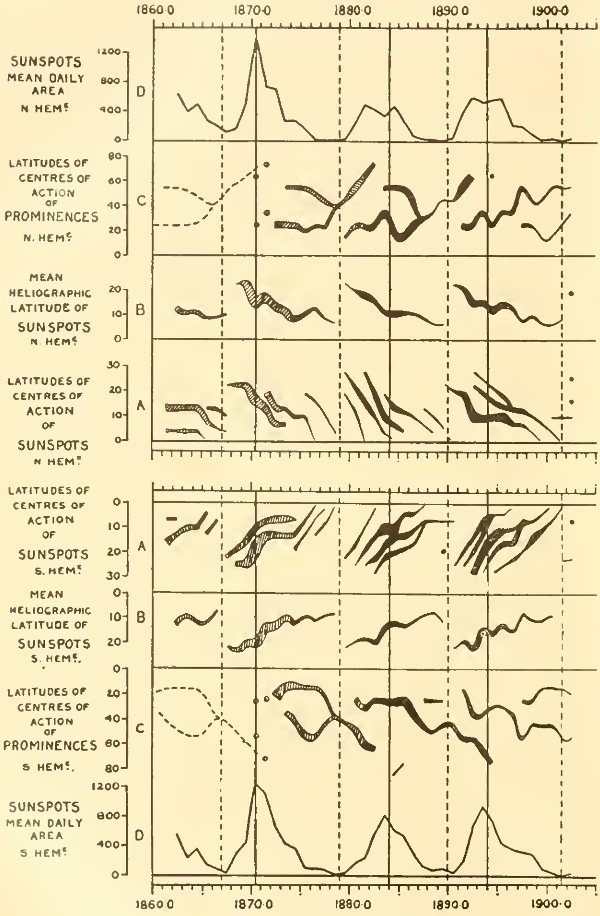


FIG. 2.—A comparison of the curves illustrating (A) spot-activity tracks; (B) mean heliographic latitude of sun-spots; (C) prominence-activity tracks; (D) variation of spotted area. (The continuous and broken vertical lines indicate the epochs of sun-spot maxima and minima respectively, the two hemispheres being taken together.)

For the sake of comparison, curves B, C, and D have been added. Curves B show the variations of the mean heliographic latitude of the total spotted area for each hemisphere. Curves C illustrate the distribution and changes of position of the centres of prominence activity, or "prominence-activity tracks" as they may now be called. The small circles in the years 1870–1871 represent Respighi's observations, the curves from 1872–1881 those of Secchi and Tacchini, and the remainder, up to the year 1902, Ricco and Mascari's observations. The dotted curves previous to 1870 are intended

only to give a rough idea of the prominence variations based on a repetition of the observations of 1872–1885. The last curves, namely, those marked D, represent the variation from year to year of the total spotted area on each hemisphere of the sun. The vertical broken and continuous lines indicate the epochs of sun-spot minima and maxima as determined by combining the amount of spotted area on both hemispheres of the sun.

Considering now the curves marked A, the following *general* deductions may be made :—

From sun-spot minimum to minimum there are three, but generally four, distinct "spot-activity tracks," or loci of movements of the centres of action of spot disturbance.

The first appearance of each of these "spot-activity tracks" occurs generally between a sun-spot minimum and the following maximum. After about the epoch of maximum no new "spot-activity tracks" of large magnitude are generally commenced.

Their first appearance is mostly in higher latitudes than 20° in each hemisphere.

They are faintly indicated at first, become more prominent and distinct, and finally thin out and fade away.

They all fade away in regions close to the equator.

There seems to be a tendency for each successive "spot-activity track" to make its appearance in latitudes higher than the one preceding it.

At, or a little after, the time of sun-spot maximum there is also a tendency for each "spot-activity track" to retain its latitude for a short time.

It is interesting now to examine these curves (A) in relation to those marked B, which, as previously pointed out, represent the drift from year to year of the mean heliographic spot latitude and illustrate Spörer's "law of zones." These latter (curves B) are individually really nothing more than the *integration* of the corresponding curves A. Every change of curvature in curves B is due to either the outburst of spots in another "spot-activity track" or to one "spot-activity track" becoming more intensified in relation to another, or, lastly, to the extinction of a "spot-activity track" as the equator has been reached, as shown in the curves A.

To illustrate this, let the curve for the mean heliographic spot latitude in the southern hemisphere (curves B) beginning in the year 1879 be considered. This is practically the period referred to above by Dr. Braun.

At this time there is only one "spot-activity track" (latitude 22°) in existence, as shown in curve A, so curve B consequently commences in the same latitude. By the next year the "spot-activity track" (curves A) has reached latitude 17°, and a new one has made its appearance in latitude 25°. Curve B, therefore, takes the mean position of about 20° when allowance has been made for the difference of intensity of these two tracks.

In the following year, 1881, both these "spot-activity tracks" have approached nearer the equator, but another has appeared in latitude 25°, so that the mean latitude for the whole hemisphere has only slightly changed.

By the year 1882 still another "spot-activity track" has come into existence in latitude 28°, while the first "spot-activity track" mentioned above has vanished. The mean latitude for the whole hemisphere, as is indicated in curve B for this epoch, is increased to latitude 20°. After this all three "spot-activity tracks" approach the equator, and curve B does the same, but owing to the relative changes in the amount of the spotted area in each of these "spot-activity tracks," as indicated by their thickness, the mean heliographic latitude curve suffers another change of curvature in 1885. In a similar way the various changes of curvature in all the other curves (curves B) can be accounted for.

Particular attention has been directed above to the fact that about the times of sun-spot maxima there is considerable spot-activity in the highest spot latitudes, which according to Spörer's law would not be expected. If reference be made to the sun-spot observations of Messrs. De La Rue, Stewart, Lœwy, and also to those by the Wilna observers, it will be seen that as early as 1872 it was pointed out, as an unlooked for fact, that at the sun-spot maximum of 1871 numerous spots appeared in high (spot) latitudes.

Finally, if a comparison be made between the curves A and C it will be seen that from the time of a sun-spot minimum, when the "prominence-activity tracks" are approaching more rapidly high latitudes, up to about a sun-spot maximum, when they reach their highest positions, nearly all the "spot-activity tracks" come into existence. Further, the nearer the "prominence-activity tracks" approach the poles the higher in latitude do these "spot-activity tracks" make their appearance, and this is the case for each hemisphere of the sun separately.

What the actual connection between these two different systems of currents is, it is not possible yet to say, but these facts suggest a close relationship.

The result of the present investigation thus leads to the following conclusions :—

(1) Spörer's law of spot zones is only approximately true, and gives only a very general idea of sun-spot circulation.

(2) Spörer's curves are the *integrated* result of two, three, and sometimes four "spot-activity track" curves, each of the latter falling nearly continuously in latitude.

(3) Spörer's and many other previous reductions have indicated the peculiar "wavy" nature of the integrated curve, which peculiarity is here shown to be for the most part real and not due to errors of observation, &c.

(4) Outbursts of spots in high latitudes are not restricted simply to the epochs at or about a sun-spot minimum, but occur even up to the time of sun-spot maximum.

(5) The successive commencement of the "spot-activity tracks" in higher latitudes between a sun-spot minimum and maximum seems to be closely related to the "prominence-activity tracks" at these periods.

WILLIAM J. S. LOCKYER.

THE DUNEDIN MEETING OF THE AUSTRALASIAN ASSOCIATION.

THE tenth session of the Australasian Association for the Advancement of Science was opened at Dunedin, New Zealand, on January 6, under the patronage of His Excellency the Earl of Ranfurly, the Governor of New Zealand, who took the chair at the inaugural meeting in the absence of the past president, Captain F. W. Hutton, F.R.S., whom ill-health prevented from attending.

The president, Prof. T. W. E. David, F.R.S., of Sydney, took as the subject of his address, "The Aims and Ideals of Australasian Science." Although this was wholly local in immediate interest, it was an extremely valuable epitome of the work already done by Australasian men of science. He dwelt upon the value of organisation in scientific research, and of the investigations carried out by research committees appointed at the meetings of the Australasian Association for the Advancement of Science. He applauded the good work done by the New Zealand Government in the preservation of the fauna and flora of New Zealand by the establishment of reserves, as well as in the establishment of a magnetic observatory at Christchurch, and urged the Commonwealth and State Governments of Australia to follow this lead.

In discussing the "Aims and Ideals," Prof. David, amongst other matters, referred to the proposed establishment in New South Wales of a branch of the Lick Observatory, to the importance of investigating the nature of the aurora australis, of carrying out a geodetic survey of Australia, and of continuing to support the high-level meteorological stations on Mt. Koscuisko. He insisted on the crying need for a systematic geological survey of New Zealand, and for the identification by competent palæontologists of the numerous fossils now stored in the Colonial Museum at Wellington, where there are "30,000 specimens in the museum cases, most of which are unnamed, and in the cellars about 500 unopened boxes full of undescribed fossils."

The president is of opinion that "nowhere in the southern hemisphere is there such a thorough and complete record of the succession of animal and plant life from the close of the Palæozoic time up to the present as in New Zealand, and nowhere else is there evidence of such a wonderful range of the Spiriferidæ high up in the Mesozoic rocks."

That important line of work in modern geology, viz. "the

reading of the past geographical history of a country from a study of its surface features," has already found exponents in Australia; it must be continued also in New Zealand. He went on to refer to the "wonderfully developed alkaline series of eruptive rocks" which have been and are at present receiving attention in various parts of Australasia, and characterised the tuffs around Dunedin as being "one of the most interesting groups of its kind in the world."

In biology he dealt with Mr. Chas. Hedley's important study of the molluscan fauna in the ocean near the edge of the continental shelf of East Australia, and pointed out the desirability of examining this fauna off the shore of New Zealand (a committee was later appointed to initiate this investigation).

Prof. David passed on to the importance of marine biological stations, and expressed his satisfaction that recently the New Zealand Government, at the instance and with the aid of the Otago Institute and the Otago Acclimatisation Society, had already established such a station near Dunedin. He reviewed some of the more important recent work by various biologists on the fauna and flora of Australasia, and noted the publication, under the editorship of Captain Hutton, of the "Index Faunæ Novæ Zealandiæ."

In reference to geography, he naturally looked forward to interesting results from the work of the various Antarctic expeditions as bearing on the former extension and connection of these southern lands. After dealing with the oceano-geographical work that has recently been carried out off the Australian coast, Prof. David expressed the opinion "that it would be possible to put a bore down in the bed of the ocean at a depth of about 100 fathoms, and in such a way as to secure a core of the strata encountered. If the boring at these shallower depths were successful, attempts would be made to bore at greater depths."

In discussing agricultural studies, he stated that "an important fact of late brought into prominence is that the barren-looking red soils of the west plains of New South Wales are formed of material which is exceptionally rich in mineral plant food." After indicating other lines of work which ought to be carried out, the president insisted that "the importance of science to national wealth can scarcely be overestimated, but the advance of education should be our grandest ideal."

He then turned to the "duty of the association in science teaching," quoting Sir Norman Lockyer's address to the British Association, as well as the reports, lectures and writings on the subject by various Australasian men of science, and emphasised the need of carefully thought out schemes of science teaching in elementary schools along "heuristic" lines.

As an outcome of the address a committee was appointed to inquire into the science teaching of these colonies, and to suggest a way in which it could be made effective in primary and secondary schools, colleges and universities.

The following are the authors and titles of the presidential addresses to sections:—Prof. W. H. Bragg, of Adelaide, some recent advances in the ionisation of gases; Mr. Brownlie Henderson, of Brisbane, chemistry and food; Mr. W. H. Twelvetrees, of Tasmania, some aspects of modern petrology; Colonel Legge, of Tasmania, on the relationship of the avifauna of Australasia with that of Austro-Malayan and Polynesian regions; Prof. Baldwin Spencer, F.R.S., of Melbourne, dealt with totemism in Australia; Mr. T. W. Kirk, Government biologist, Wellington (in the absence of the president), gave a short account of the importance of agriculture. The president of the section for architecture and engineering, Mr. H. Deane, engineer-in-chief of railway construction in New South Wales, discussed day labour on Government works; Dr. Frank Tidswell, of the Department of Public Health, Sydney, spoke on the hygienic aspect of boric acid; Mr. John Shirley, chief inspector of schools, Brisbane, took education and national trade competition, in the mental science and education section; and Prof. J. W. Gregory, F.R.S., of Melbourne, discussed the Southern Ocean and its climatic control over Australasia.

Among the papers read before the various sections, the following are of more than local importance:—Dr. Coleridge Farr, of the Christchurch Magnetic Observatory, on some continuous observations on the rate of dissipation of electrical charges in the open air, showed that in ordinary weather the atmosphere is a better conductor for negative than for positive charges, but during the "Canterbury nor'-westers" the reverse is the case.

A communication on the heating effect of radium emanation, by Prof. Rutherford, was presented.

Dr. Greig Smith, of Sydney, in a paper on the production and identification of vegetable gums, showed that some gums are the products of certain bacteria, which inhabit the tissues of the gum-bearing trees. The bacteria were isolated and made to produce their gums in the laboratory. Thus "arabin," the soluble gum of wattles, "metarabin," the insoluble gum of wattles and of certain fruit trees, and "pararabin," the insoluble constituent of Sterculia gum, are each produced by a distinct bacterium. The author suggests that all other vegetable gums are bacterial products, and that the world's supply of gum might be increased by judicious injection of susceptible trees.

Prof. Easterfield and Mr. G. Bagley (Wellington), in the chemistry of colophony, raised the question whether any particular chemical structure is common to the resin acids obtained from coniferous trees.

Prof. Easterfield and Mr. B. C. Aston, in the acids of some New Zealand timber trees, find that the resinous matter contains crystalline constituents, to which the name "rimuic acid" is given, closely related to "podocarpic acid," which occurs in one of the timber trees of Java.

In the geology section, Dr. P. Marshall (Dunedin) described a trachydolerite from Dunedin; this rock, which has a very peculiar association of minerals, belongs to a rare type, which has been described also from East Africa.

An important note on the geology of the New Hebrides, by Mr. D. Mawson, showed that at Sandwich Island there is a series of raised coral reefs, at least nine in number, up to a height of 2000 feet above sea-level. The coral rock occurs as a mere veneer over fine-grained submarine tufaceous muds, like "Fiji soapstone," or over other volcanic rocks. At Santo three unconformable series of rocks were discovered, the oldest of which is a tufaceous calcareous group, dipping off the syenites at an angle of 50°; this contains vast numbers of foraminifera (Orbitoides), showing that the oldest rocks in the New Hebrides are not older than Tertiary.

In Section D, Miss G. Sweet described the structure of the eye of Notoryctes, the marsupial mole. The eye has sunk below the surface, and is merely represented by the pigmented choroid, all trace of iris, lens, retina and optic nerve having practically disappeared. The lachrymal gland, however, is of great size, and opens into a closed conjunctival sac, derived from the closure of the eyelids of the eye-vestige; thence the naso-lachrymal duct takes the usual course.

Prof. Chilton, of Christchurch, read papers on some subterranean isopods.

In the anthropological section, Mr. E. Tregear, of Wellington, in a paper on the language of Maori and Malay, drew a comparison between the language of Celebes islanders and that of the Polynesian; a considerable number of words are identical in the two languages, too great to be a coincidence, suggesting, probably, a derivation from a common ancestral language or from one another.

Prof. Baldwin Spencer gave an account of fire ceremonies in Australia.

In the agricultural section Mr. J. A. Gilruth, Wellington, read a note, and gave a demonstration, of a means of making innocuous injections of virulent cultures of anthrax. This he does by inoculation with a mixture of the culture of anthrax bacillus with some non-pathogenic microbe, in certain proportions. He also pointed out the toxic effects of ragwort (*Senecio jacobaea*) upon cattle and horses, resulting in a disease known in Nova Scotia as "Picton disease," and in New Zealand as "Winton disease." Sheep can eat the weed with impunity, but direct experiments show that in the case of cattle and horses inflammation of the liver ensues, which causes death.

An evening lecture was given by Prof. Baldwin Spencer on the Central Australian aborigines, their habits and customs. This was illustrated by numerous lantern slides showing the aborigine from infancy to old age, and by

kinematographic and phonographic records of corroborees and ceremonies. The lecture was an outcome of two journeys with Mr. Gillen from Adelaide to the Gulf of Carpentaria; the most important ceremony, not dealt with in their book, referred to certain burial customs, notably the removal of the bones from their first "tree-grave," their burial in an ant-hill, but the reservation of one arm-bone for future elaborate ceremonial, which was shown by the kinematograph.

The session, at which nearly 1000 members and associates were present, closed on January 13.

At the close of the session the "Marine Fish Hatchery and Biological Station," situated in the Otago Harbour, was visited and formally opened, although it is not yet complete. The establishment of this, the first biological station in Australasia, is the outcome of the persistent efforts of Mr. Geo. M. Thomson, of Dunedin.

On the following day a small party—Mr. Hedley, Prof. Benham, and Prof. Kirk—made an excursion to the edge of the "continental shelf," which is about 15 miles due east of the Otago Head, but owing to the rough sea part of the deep-sea dredging gear was carried away as it was being hauled up, and later efforts with other gear resulted in but a small reward for the day's work. The association has made a grant for pursuing this work.

BREWING AND RESEARCH.[1]

IN 1901 the great brewing firm of Messrs. Guinness in Dublin instituted a research laboratory, in which the work has been conducted by four trained investigators under the direction of Dr. Horace T. Brown. With characteristic generosity, Messrs. Guinness have rendered the results so far obtained available for other workers in the same field by the publication of a first volume of *Transactions*. Appreciation of these results will by no means be confined to the circle of scientific men technically interested in brewing, for Messrs. Guinness' investigators have been seeking for that exact knowledge which is of permanent scientific value and at the same time affords a basis whereon technical process can be built with some degree of confidence and promise. The problems of the brewer really appeal to a very wide circle; because they are the problems involved in the biological chemistry of the germinating plant and of the yeasts and other lower organisms, they become the problems of the plant physiologist, of the agricultural chemist, and even of the animal physiologist. As Dr. Brown says in his preface, "Could we determine, in the early stages of the germination of a grain of barley, all the 'down grade' chemical changes of the nitrogenous substances stored in the endosperm, and follow the products as they enter the embryonic plant and are once more built up into proteid, we should have a key to many obscure problems connected with the life processes of plants and animals."

The first problem dealt with in the present volume is the investigation of the nitrogenous constituents of malt, *i.e.* of the soluble bodies which are formed by the hydrolysis of the barley proteid under the action of the enzymes produced during germination, or which may turn out to be built up from simpler substances as the new plant develops. No one who has not worked amongst that maze of bodies generally "lumped" as amides can appreciate the thick darkness which envelops their separation, and consequently all attempts to appreciate their physiological significance. In the first place Dr. Brown decided upon a critical examination of the various processes which have been proposed for the determination of bodies of the amide and amino acid type; none of the previous results, not even those of Schultze, hitherto the chief worker in this field, have been accepted without examination, and the figures given show the need for revision that existed.

As a result, the Sachsse method, which depends on the hydrolysis of the amide group, and the Sachsse-Korman method, which depends on the reaction of the amide and amino group with nitrous acid, have been improved until they are capable of giving exact results, as tested with pure specimens of asparagin, aspartic acid, glutamic acid, leucine, tyrosine, alanine, &c. Thus by a combination of the two methods the amount of nitrogen present in a complex mixture as amide and as amino acid can be distinguished and determined. A novel and exact method for the direct determination of tyrosine in such mixtures has also been devised.

Much yet remains to be done before each one of these bodies can be estimated separately, probably, as Dr. Brown indicates, by the application of E. Fischer's esterification method, but the processes here set out with careful detail will be of the greatest possible service to other workers in plant chemistry.

Another old stumbling block has been the want of an accurate method for the estimation of so fundamental a substance as starch; O'Sullivan's method is exact enough, but is too prolonged to be anything but a research method, whereas it is often desirable to repeat starch determinations by the dozen. The volume contains a critical examination of a new starch method, which depends on a preliminary removal of the reducing sugars, &c., with alcohol, followed by hydrolysis to the standard conditions which have already been laid down by Brown and Morris, whereupon the maltose is determined by its cupric reducing power. This method is likely to be of general service in the analysis of a large number of bodies containing starch.

Finally, the volume contains an examination from the plant physiological side of the factors associated with "quality" in barley, including an interesting cytological test of maturation.

The standard of the work recorded in these papers is so high, and their value so great to all others who are engaged with the chemistry of the plant and plant products, that we can only again express our thanks to Dr. Brown and his co-workers, and to Messrs. Guinness for allowing the record of their investigations to be made public. Would there were many great industrial firms with the same enlightened views on research! A. D. H.

[1] *Transactions* of the Guinness Research Laboratory, vol. i. part i. Pp. 141. (1903.)

MARINE BIOLOGY.

THE number of the *Journal* of the Marine Biological Association recently issued (new series, vol. vi., No. 4) contains a detailed report on the trawling and other investigations carried out by the association in the bays on the south-east coast of Devon during 1901 to 1902. The report has been prepared for the information of the Devon Sea Fisheries Committee by Mr. Walter Garstang, the naturalist in charge of the fishery investigations of the association, and is based upon a series of experimental trawlings and fish-marking experiments carried out by Dr. H. M. Kyle. The bays investigated are at present closed to trawlers, and as this closure has been found to press somewhat hardly on the smaller fishermen, the Sea Fisheries Committee were anxious to ascertain to what extent it was likely to be beneficial to the fisheries of the district as a whole. The general conclusion arrived at in the report is that, having regard to the permanent maintenance of the fishery, it would appear to be highly inadvisable to rescind the regulation which prohibits trawling in Teignmouth Bay and Torbay, where small fish congregate. On the other hand, there are no biological reasons against the reopening of Start Bay, since small fish are found in inappreciable numbers, whilst large plaice concentrate there during the autumn months.

A particular feature of these experiments was the success attained in the study of the migrations of plaice by marking individual fishes, which were subsequently recovered by the fishermen. Of 349 fish 9 inches and upwards in length marked and liberated in the bays, 96 were subsequently recovered, that is, 27·5 per cent., whilst of 71 fish liberated outside the bays 25 were recovered, or 35·2 per cent. The fishes had in many cases travelled considerable distances.

To the same number of the *Journal* Dr. Petersen, of Copenhagen, contributes a paper entitled "What is Over-fishing?" in which an attempt is made to define the problem now receiving so much attention from those responsible for fishery administration. Dr. Kyle furnishes notes on the physical conditions existing within the line from Start Point to Portland, and a paper on fishing nets,

with special reference to the otter-trawl. Mr. R. A. Todd writes on the invertebrate fauna and fish-food of the bays between the Start and Exmouth, Mr. Robert Gurney on the larvæ of certain British Crangonidæ, and Mr. Frank Balfour Browne on the eggs and larvæ of Teleostean fishes. The number, which is of larger size than usual, contains three plates and a chart.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—The Smith's prizes in natural philosophy for Bachelors of Arts are awarded to Mr. E. Cunningham, St. John's; Mr. J. C. M. Garnett, Trinity; Mr. H. A. Webb, Trinity; and Mr. P. W. Wood, Emmanuel. The names are in alphabetical order, and are respectively those of the senior wrangler, sixteenth wrangler, and the two (bracketed) third wranglers in 1902.

The Worshipful Company of Girdlers has made a grant of 100*l.* a year to the university for the endowment of a university lecturer in economics. The appointment is in the first instance for three years.

The general board proposes the appointment of an assistant curator of the Botanical Museum at a stipend of 100*l.* a year.

A special syndicate proposes the establishment in the university of a board of anthropological studies, for the purpose of systematising and directing work in anthropology by advanced students.

Prof. Adami and Prof. Bovey, F.R.S., of McGill University, Montreal, have been appointed representatives of the university at the jubilee of the University of Wisconsin, to be celebrated at Madison in June.

The Senate has adopted an address of sympathy with the University of Turin on the destruction by fire of the Biblioteca Nazionale.

DR. G. E. RICHMOND has been appointed demonstrator of hygiene and public health at University College, London.

THE Misses Riddell, of Beckmount, Belfast, have presented 5000*l.* to Queen's College, Belfast, for the establishment of a Riddell demonstratorship of pathology.

WE learn from *Science* that Lord Strathcona has given 4000*l.* to Manitoba University to extend its scientific work, and that Mr. John A. Creighton has given a further sum of about 50,000*l.* to Creighton University, a Catholic institution at Omaha, Nebraska.

THE death is announced, at the early age of thirty-nine, of Dr. E. A. de Schweinitz, director of the Biochemic Laboratory of the U.S. Department of Agriculture, dean of the Medical Department of Columbia University, and well known for his contributions to bacteriology.

A BILL on higher education has, says a *Times* correspondent, been introduced in the Second Chamber of Holland by Dr. Kuyper. The Bill has for its object the granting to private universities, under certain guarantees, of the same rights and privileges as are accorded to the State universities, including the faculty of conferring degrees upon students wishing to enter the public service. The Premier, it appears, attaches great importance to this piece of legislation, and the *Standaard*, the recognised organ of his party, has already threatened the resignation of the Cabinet should the Government fail to obtain a majority in the final division.

THE authorities of the Yorkshire College, Leeds, have received a letter from the Committe of the Privy Council to announce that the committee "see no reason to modify their opinion that the proper title to be assumed by a university with its seat in Leeds is the University of Leeds." Their lordships have recommended to His Majesty the restriction of the title, both on the score of precedent and convenience. The Charter will now soon be laid on the table of the House of Commons, and it is not expected there will be any further delay in the matter. The movement for a new university at Leeds, towards establishing which some 40,000*l.* has been promised, has been throughout regarded as a county movement. The West Riding County Council has promised something like 6000*l.* in the aggregate annually towards the Leeds and Sheffield Universities.

IN a lecture at University College, London, on the universities and colleges of the United States, Dr. T. Gregory Foster, one of the members of the Mosely Education Commission, referred to social and industrial conditions as affecting university life. He pointed out that at every university and college he visited—whether at ancient Yale and Harvard or at the infant University of Chicago, or at the State universities—at all alike one found rich and poor. Each university issued a leaflet to show how the poor man could pay, or help to pay, his way during the university course without loss of caste. Business men in the United States are glad to employ men who have more than a common school or high school education. There is a certain prospect of employment for all who have passed through a university course.

THE Committee of the Privy Council has considered the case presented on behalf of the petition of the University College of Sheffield praying for the grant of a Charter incorporating a university in Sheffield and the resolutions in its support adopted by various bodies. The committee understands that the promoters are engaged in raising a sum of 170,000*l.* for the purposes of the university, by the appropriation of part of which new buildings of a suitable character will be in readiness by the spring of 1905, and that in addition to a considerable yearly sum which the city council has promised to provide, material assistance may be looked for from the county council of the West Riding of Yorkshire, and probably from Derbyshire and the large urban communities in the neighbourhood of Sheffield. In these circumstances their Lordships are willing to entertain favourably the application, and, subject to a substantial realisation of the hopes mentioned, will be prepared to recommend to His Majesty the grant of a Charter in general conformity with the draft accompanying the petition.

MR. LYTTELTON, Secretary of State for the Colonies, was the guest of the Liverpool University Association on March 5 on the occasion of the first dinner under the auspices of the association. The right hon. gentleman, in replying to the toast of his health, said "the object of all education is to endow the mind of the student with strength, accuracy, and elevation. It is well also that such a mind should have power to express its thought with clearness and, if possible, with attractiveness. That is the reason that classical languages have been for so long the main study of the country. But things have altered now. Around and competing with us are all the great communities of Europe, which are becoming more and more organised, intelligent, and specialised in knowledge. Hence has arisen a necessity for the equipment of our young men by study for the immediate struggles of life. We have been frequently met by the criticism that to teach the young to snatch greedily at mental improvement with the sole purpose of disposing at a profit of what has been learned is but a narrow education; but it is well competent for us to learn worthily the great principles which underlie practical professions, and not to despise those principles because they have practical achievement as their result."

MR. GRAY, M.P., has asked in Parliament for an explanation why the Board of Education have recently reduced the value of the national and research scholarships from 30*s.* to 25*s.* per week, and whether, having regard to the desirability of keeping these scholarships open to students unable to supplement them by private means, he would advise the Board to reconsider their decision. In the course of his reply to the question, Sir W. Anson remarked:—"The Board have never intended that these scholarships should be of an eleemosynary character. They believe that the amount of the scholarships is sufficient to attract good candidates, and that in the majority of cases they provide an adequate supplement to the other resources of the students, and they consider that in any cases where more is needed the assistance should be provided under the supervision of local authorities rather than from funds administered by the Board. The students who gain these scholarships have, as a rule, been for a period of years under the direct observation of local school authorities, who thus

necessarily possess, or can readily obtain, a more intimate knowledge of the circumstances of each student than can the Board. The scholarships now provided by local authorities offer in many places the further assistance required. In these circumstances I do not consider it desirable that the decision of the Board be reconsidered." It would be interesting to know how many national scholars receive any assistance from local authorities or have any resources beyond the 25s. per week now allowed them by the Board. Certainly it is desirable for local bodies to supplement the value of national scholarships, but while the Board of Education and local authorities are evading responsibility for support, the students who have not the additional resources referred to by Sir W. Anson have to cultivate high thinking on very poor living. The only satisfactory solution of the difficulty is the provision of a hostel or residential college so that students may learn something of the corporate life which should be an essential part of a university education.

SOCIETIES AND ACADEMIES.

LONDON.

Chemical Society, February 17.—Dr. W. A. Tilden, F.R.S., president, in the chair.—The following papers were read :—Observations on some intramolecular and originally reversible changes extending over prolonged periods of time : R. J. **Friswell.** It was suggested (1) that the labile condition is not confined to hydrogen, and (2) that the constitution of a compound may vary according to the particular "stress" to which it is subjected. Experiments illustrating these points were described, such as the slow decomposition of aniline hydrochloride by aminoazobenzene even in presence of excess of aniline.—Note on magnesium oxybromide : G. W. F. **Holroyd.** This substance was obtained by saturating an ethereal solution of magnesium phenyl bromide with acetylene, when it separated in the form of colourless crystals consisting of one molecule of the oxybromide with two molecules of "ether of crystallisation."—The arrangement in space of the groups combined with tervalent nitrogen atoms : F. S. **Kipping** and A. H. **Salway.** The authors have attempted to detect asymmetry in a number of tervalent nitrogen compounds by treating these with *d-l*-benzylmethylacetylchloride. The products of these reactions remained homogeneous after fractional crystallisation, whence they conclude that the three radicles and the tervalent nitrogen atom itself in such compounds are situated in one plane, and that each pair of the radicles is symmetrically situated with regard to the third.—The esterification of *r*-mandelic acid by menthol and borneol : A. **McKenzie.** The esters obtained were described.—Certain organic phosphorus compounds : A. E. **Dixon.** Phosphorus trithiocyanate, a colourless oil readily hydrolysed by water into phosphorous and thiocyanic acids, and phosphoryl trithiocyanate, a pale yellow, highly refractive oil, were obtained respectively by the action of phosphorus trichloride and phosphorus oxychloride upon ammonium thiocyanate. These substances behave both as thiocyanates and thiocarbimides, and this tautomerism is being further investigated.—Note on the relation between the chemical composition of some organic substances and the densities of their solutions : C. E. **Fawsitt.** Determinations of the densities of solutions of homologous carbamides, amines and acids have shown that this property is of an additive character, though slightly modified by constitutional influences.—The so-called hydrocellulose : A. L. **Stern.** It was shown that the pulverulent substance formed by the action of dilute acids upon cellulose contains soluble hydrolytic products, and that the bulk of the material has the same composition as cellulose.—(1) Isomeric change of diacylanilides into acylaminoketones ; (2) intramolecular rearrangement in derivatives of the aromatic aminoketones : F. D. **Chattaway.**

Royal Microscopical Society, February 17.—Dr. Hy. Woodward, F.R.S., vice-president, in the chair.—A paper by Mr. **Stringer** on an attachment for reading the lines in a direct vision spectroscope was read. The attachment consists of a light rigid arc of phosphor-bronze of about 40 degrees and $6\frac{1}{4}$ inches radius, cast in one piece with two radial arms that project from a broad ring, by which it is clamped to the body of the instrument. It lies just below the telescope, which is traversed across the spectrum by a screw that works through one of the radial arms and presses against a lug projecting downwards from the telescope to which it is clipped. A spring attached to the other radial arm acts on the opposite side of the lug and forces the telescope back when the motion of the screw is reversed. The arc carries a millimetre scale, divided in white on a black ground, and a vernier reading to tenths is carried by the telescope. Immediately below the eye-piece is a magnifying lens through which the scale and vernier can be read without any change in the observer's position.—A paper by Mr. **Nelson** on the vertical illuminator was then read. The author said that after lying in abeyance for twenty-five years, the vertical illuminator has lately come into notice for the examination of opaque objects and especially for the microscopic examination of metals. He said a vertical illuminator must not be an oblique illuminator only, but must be capable of illuminating the full aperture of the back lens with a parallel beam of light. It must not be a permanent attachment to an objective so as to impair its performance for ordinary work. The reflector must be placed near the back lens, and there must be some method for regulating the illumination. To obtain the best advantage with vertical illumination it is necessary to use oil immersion objectives.—Another paper by Mr. **Nelson** on the influence of the antipoint on the microscopic image shown graphically was read. The author referred to a paper in the *Journal* for 1903 on a micrometric correction for minute objects, wherein he stated by way of illustration that if one of the minute spinous hairs on a blowfly's tongue was examined on a bright ground and on a dark ground, a considerable difference in the sizes of the two images was discernible, and that the difference was caused by antipoints. A table was also given showing the amount to be added to the micrometric measurements of the image seen on the bright ground to bring it up to its true value. Mr. Gordon, who had originated the theory of the antipoint, had made accurate drawings of the two images of the hair, and the ratio of the breadths of the hair in these drawings was as 45 to 65. Applying the corrections given in the table to the measurement of the apparent size of the hair on a bright ground, the actual size works out to 12 per cent. more.—Mr. Keith **Lucas** followed with a paper on a microscope with geometric slides. He defined a geometric slide as one in which each motion which is not desired is separately eliminated by a single stop so arranged as not to interfere with any other possible motion. This principle he had applied in the design of a microscope to the slides of the fine and coarse adjustments and to the substage.

Royal Meteorological Society, February 17.—Captain D. Wilson-Barker, president, in the chair.—Mr. E. **Mawley** presented his report on the phenological observations for 1903. He showed that owing to the mildness of the winter and early spring wild plants flowered in advance of their average dates until about May, after which time only backward dates were recorded. In no previous year since the present series of reports was first instituted, in 1891, have such spring migrants as the swallow, cuckoo, and nightingale been so late in reaching our shores. The yield of wheat, barley, potatoes, turnips, and swedes was somewhat under average, but all the other farm crops yielded well, especially those of hay and beans, which were unusually abunoant. On account of the wet and protracted harvest most of the grain of the cereals was more or less discoloured, while potatoes were almost everywhere much diseased. Throughout the country this was one of the most disastrous years for fruit ever known. In fact, the only crop which gave anything like an average yield was that of strawberries.—Mr. W. H. **Dines** gave an account of the observations which he had made by means of kites at Crinan, off the west coast of Scotland, during last summer. These observations were carried out by Mr. Dines under the auspices of a joint committee of the Royal Meteorological Society and of the British Association, the Government Grant Committee of the Royal Society providing funds for the hire of a vessel for the purpose. The author, after describing various improvements which he had effected in the kites, stated that the weather last summer was most un-

favourable for kite flying, as not only was there heavy rainfall, but gales were of frequent occurrence. The results of the observations show that in August last the mean temperature gradient for the first 5000 feet was 3°·2 per 1000 feet. This is substantially the same as that obtained during the preceding summer, although the conditions of weather were very different.

Linnean Society, February 18.—Prof. S. H. Vines, F.R.S., president, in the chair.—Mendel's laws and their application to wheat hybrids: R. H. **Biffen**. An investigation of the various characters of the different races and varieties of wheat showed that the following characters were dominant:—beardless paleæ, keeled glumes, lax ears, velvet chaff, grey coloration, red coloration in the chaff and red coloration in the grain, the corresponding recessive characters being bearded paleæ, rounded glumes, dense ears, glabrous chaff, white coloration in the chaff and grain. Evidence was brought forward to show that certain anatomical characters, such as the presence of groups of bristles, the arrangement of sclerenchyma girders, the presence or absence of pith in the internodes, also followed Mendel's laws. The same also appears to be true of certain "constitutional" characters, such as the time of ripening and the immunity to attacks of rust.—Mr. W. **Bateson**, F.R.S., exhibited a series of *Primula sinensis*, about 240 in number, lent by Messrs. Sutton and Sons, illustrating the phenomena of heredity and variation which he had been permitted to witness in their nurseries during five seasons. As was well known, the species, since its introduction about 1820, had given off numerous mutational forms, *e.g.* fern-leaved, ivy-leaved, the "*stellata*" type, and others. Many of these in their inheritance follow simple Mendelian rules.

Anthropological Institute, February 23.—Mr. H. Balfour, president, in the chair.—The Hon. W. L. **Allardyce**, C.M.G., delivered a lecture on the Fijians in peace and war. The lecturer directed attention to the native legend of the colonisation of the islands, and pointed out the presence of two types, a Melanesian and a Polynesian. Passing to their domestic life, he described their methods of personal adornment, houses, food, industries, and canoes. He then gave an account of the punitive expedition of 1894, in which he had taken part, and described the native methods of warfare. Finally, he gave a very interesting description of the fire-walking ceremony on Mbengha.

Physical Society, February 26.—Dr. R. T. Glazebrook, F.R.S., president, in the chair.—A new dilatometer, exhibited by Mr. B. Bonniksen, was described by Mr. B. F. E. **Keeling**. The instrument was originally designed for measuring the expansion of balance-wheels of watches, and has latterly been applied to the determination of the coefficient of dilatation of specimens of materials, used in the form of wires about 1¼ inches in length. The increase in length with change in temperature is magnified about 1500 times by means of a chain of accurately mounted gear-wheels, the last one of which moves a pointer over a circularly graduated scale. With an ordinary specimen of steel one degree rise in temperature causes a movement of the pointer over about one-third of a scale-division, and a mean coefficient of expansion of such a substance over a range of 100° C. can be obtained to about 1 per cent. in a single experiment of five minutes' duration.—A quartz-thread vertical force magnetograph: Dr. W. **Watson**. The instrument resembles, in principle, the quartz-thread gravity balance of Prof. Threlfall. In addition to the advantages derived from the suppression of the knife-edge, the instrument can be simply and accurately compensated for the effects of changes of temperature. The principle of the instrument is to have a magnet suspended on a horizontal quartz fibre kept stretched by means of a spring. The centre of gravity of the magnet and the torsion of the fibre are so adjusted that the axis of the magnet is horizontal. Any variation of the vertical force produces a rotation of the magnet about the fibre which can be suitably recorded by means of a mirror attached to the magnet. The temperature compensation is effected by weighting the magnet on the same side of the axis of the fibre as the south pole, so that the magnetic couple and the couple due to the torsion of the fibre act in the same direction. Hence, since an increase in temperature causes one of these couples to decrease and the other to increase, by suitably adjusting the weight, and therefore the magnitude of the torsion couple, complete compensation can be obtained. The suspended system in the instrument shown at the meeting consists of two magnets 8 cm. long and 1 mm. diameter attached by means of small platinum straps to two fused rods of silica, which form part of the plate of fused silica forming the mirror. The upper surface of the mirror is platinised. The fixed mirror is supported on the base of the instrument, and is capable of adjustment.—On stresses in a magnetostatic field: G. W. **Walker**. Quincke found that when a glass bulb containing a solution of ferric chloride was placed between the poles of a strong electro-magnet, the level of the liquid, in a capillary tube attached to the bulb, fell. This has been held to require for its explanation a system of stress which differs from the magnetic stresses of electrical type. The object of this paper is to show that the experiment can be quite well explained by the stresses of electrical type.—Dr. W. **Watson** gave some hints on the preparation of diagrams.—Mr. R. J. **Sowter** exhibited a portable electroscope of high insulation and adapted to show and measure the discharging effect of radio-active substances.

Zoological Society, March 1.—Dr. A. Günther, F.R.S., vice-president, in the chair.—Dr. A. **Günther**, F.R.S., exhibited and made remarks upon some specimens of hybrids between Reeves's pheasant (*Phasianus reevesi*), ♂, and the silver pheasant (*Euplocamus nycthemerus*), ♀.—Mr. Oldfield **Thomas**, F.R.S., exhibited and made remarks upon the skull of a buffalo which had been obtained by Colonel Delmé-Radcliffe in south-west Uganda. The horns differed in certain respects from those of *Bubalus caffer*, and Mr. Thomas considered the specimen to represent a distinct local race and entitled to subspecific rank. Mr. Thomas also exhibited a specimen of a fruit-bat from Fernando Po, which he described as a new species of the genus Scotonycteris.—Mr. J. G. **Millais** exhibited a series of skins illustrating the life-history of the grey seal (*Halichoerus grypus*), and made remarks upon its geographical distribution.—Mr. J. ffolliott **Darling** exhibited photographs of, and made remarks upon, a very large specimen of the woolly monkey (*Lagothrix humboldti*) which he had observed in southern California.—Dr. Walter **Kidd** exhibited a drawing of, and read a note on, the arrangement of the hair on the nasal region of the parti-coloured bear (*Æluropus melanoleucus*).—Mr. R. E. **Holding** exhibited and made remarks upon a double head of a lamb and the skull of a Spanish four-horned ram fractured in fighting.—Mr. E. R. **Sykes** read a fourth instalment of Sir Charles Eliot's paper entitled "On some Nudibranchs from Zanzibar and East Africa." It contained an account of twenty-two species of Dorididæ Cryptobranchiatæ, of which eight were described as new.—A communication from Mr. Robert T. **Leiper** contained a detailed account of the turbellarian *Avagina incola*, which had recently been described by the author, and a note on the classification of the Proporidæ.—Dr. Einar **Lönnberg** contributed a paper on two specimens of hybrid grouse between *Lyrurus tetrix* ♂ and *Lagopus lagopus* ♀.

CAMBRIDGE.

Philosophical Society, February 15.—Dr. Baker, president, in the chair.—On the occurrence of radio-active constituents in common substances: Prof. J. J. **Thomson**. The author described the results of the examination of a large number of specimens of water from different parts of England. In nearly every case the radio-active gas which occurs in Cambridge tap-water, and is probably identical with the emanation from radium, was present. In order to find the source of this gas a number of clays, gravels, and sands were examined, and it was found that in many of these radium was present. Radium was found in garden soil from the laboratory garden, in the Cambridge gault, in gravel from a pit at Chesterton, in still greater quantities in sand from the sea-shore at Whitby, in the blue lias at Whitby, in powdered glass, in one specimen of flour, and in a specimen of precipitated silica; other specimens of flour and silica did not contain any appreciable amount of radium. The question whether ordinary metals such as tin, bismuth, platinum and lead give off a radio-active emanation was investigated; no trace of such an emanation could be found even when the metals were in the exceedingly finely divided

state in which they occur in colloidal solutions, and were exposed to the bombardment of Röntgen and kathode rays. Although ordinary substances do not give off a radio-active emanation, reasons are advanced for believing that they give out rays similar to Röntgen rays.—On the temperature effect on the rate of combination of hydrogen and chlorine: P. V. **Bevan.**—On the convection of heat: H. A. **Wilson.**—On the calculation of capacities in terms of the coefficients of electrostatic induction: G. F. C. **Searle.**

Dublin.

Royal Dublin Society, February 16.—Mr. W. E. Wilson, F.R.S., in the chair.—Prof. E. J. **McWeeney** described his recent investigations on the distribution of *Bacillus coli communis, Bacillus enteritidis sporogenes,* and Streptococci in shell-fish, sand, and sea-water from various points on the Irish littoral, with special reference to the value of these organisms as evidence of sewage-contamination. The author began by referring to the evidence that had convinced hygienists that shell-fish, and especially oysters, may serve as vehicles for pathogenic organisms, especially those of enteric fever. It is along with other organic matters of sewage origin that these bacilli gain access to the oyster, hence the necessity for establishing some test whereby the actual contamination of shell-fish with sewage, and, inferentially, their potential contamination with specific disease germs, may be recognised. With this object he had, under the auspices of the Local Government Board for Ireland, carried out a systematic bacterioscopic examination of shell-fish, water and mud, collected by Dr. Browne from the several layings round the Irish coast. A leading feature of the work was its independence of the local inspection conducted by Dr. Browne. Each oyster was tested for coli and enteritidis, the quantity of the mingled shell-water and body-fluid tested being as a rule 1 c.c. The author very much doubted the positive value of enteritidis, but considered that its absence was a valuable evidence of purity. Both it and coli were absent from deep-sea oysters. Enteritidis was present in nearly 100 per cent. of oysters from a polluted locality when, for some unknown cause, coli was not demonstrable. In view of the occasional occurrence of coli in material from unpolluted localities, to condemn a laying on the strength of its presence in a few oysters from a chance batch was, in his opinion, unjustifiable. The occurrence of coli in a large percentage of molluscs from an apparently pure locality was to be taken as a danger signal, indicating the need for renewed and more stringent local inspection. The author considered that the delimitation of the species-idea *B. coli communis* was of much importance. With regard to the characters of *B. enteritidis sporogenes,* the author was in agreement with Klein.—Mr. W. B. **Wright** and Mr. H. B. **Muff** communicated a paper upon the pre-Glacial raised beach of the south coast of Ireland. A raised beach resting on a wave-worn platform which subtends an old cliff has been traced along the south coast of Ireland from Carnsore Point to Cape Clear. The beach is overlaid by "head" or "rubble drift," and by the Boulder-clays of the Irish Sea and west Cork ice-sheets. It fringes the shores of the drowned river-valleys, proving their pre-Glacial submergence. It is similar to the raised beaches on the shores of the Bristol and English Channels, and to that near Bridlington, Yorkshire.—Dr. F. G. **Donnan** read a paper on the reactivity of the alkyl iodides. This was a discussion of the relative reactivities of the saturated aliphatic iodides as measured by the determination of velocity-coefficients in a homogeneous medium. The experiments of Wislicenus, Menschutkin, Hecht, Conrad, and Brückner, and those carried out by Miss K. A. Burke and the author were discussed in this connection, and their bearing on Nef's dissociation hypothesis pointed out.

Paris.

Academy of Sciences, February 29.—M. Mascart in the chair.—The president announced to the academy the death of M. Émile Laurent, correspondant for the section of rural economy.—On quadratic forms invariant by a given linear substitution (mod. p): Camille **Jordan.**—On a condition necessary for the initial stability of any elastic medium whatever: P. **Duhem.**—On a new species of n-rays: R. **Blondlot.** These rays are differentiated from the n-rays by the fact that they diminish the luminosity of a phosphorescent calcium sulphide screen instead of increasing it. They are present, along with the n-rays, in the light of a Nernst lamp, formed into a spectrum by means of an aluminium prism. Measurements of the refractive indices and wave-lengths are given.—Peculiarities presented by the action of the n-rays on a feebly lighted surface: R. **Blondlot.** On a phosphorescent or feebly lighted screen the effect of n-rays is to increase the luminosity when the screen is viewed normally, to diminish it when viewed very obliquely. The n_1-rays, described in the previous note, have exactly the opposite effect.—On the transparency of certain bodies for the n-rays: E. **Bichat.** Silver is transparent, and palladium, nickel and iridium opaque, for all the radiations. Other metals are transparent for some wave-lengths and opaque for others.—Particular cases in the emission of the n-rays: E. **Bichat.** Liquids under pressure emit n-rays, the gases above them do not, and it is possible in this way to trace the change at the critical point by means of a phosphorescent screen.—Observation of the occultation of a star made on February 24 at the Observatory of Toulouse: L. **Montangerand.**—On the continued deformation of surfaces: G. **Tzitzéica.**—On the friction of pivoting: L. **Lecornu.** After a comparison of the expressions deduced by Léauté and by Hertz, a demonstration is given of the correctness of the former.—Method for the experimental study of the secondary movements of vehicles in motion: M. **Sabouret.**—On the diastoloscope and the results obtained by it: C. **Chabrié.** A description of a magnifying instrument in which the lenses are replaced by cones. The images are highly magnified, but distorted in a regular manner.—The stato-voltmeter, an apparatus capable of measuring electromotive forces over a range of from 2 to 40,000 volts: V. **Crémieu.**—On the magnetic rotation of the plane of polarisation of the n-rays: H. **Bagard.** From the minuteness of the wave-lengths of the n-rays, as determined by M. Blondlot, it is probable that the phenomenon of magnetic rotatory polarisation would be shown by these rays in a much higher degree than for ordinary light. This was found by experiment to be the case.—The action of magnetic fields on phosphorescent substances: C. **Gutton.** An increase in the lustre of a phosphorescent screen is observed whenever variations in the intensity of a magnetic field produce a displacement of the lines of force in the neighbourhood of the screen.—Appearance of the sparks given by a coil with a Wehnelt interruptor on closing or opening the primary current: M. **Gagnière.**—On entanglement by coagulation: Jacques **Duclaux.**—Theoretical study of the dissociation of oxyhæmoglobin. The effects of concentration and temperature: Victor **Henri.** By the application of van 't Hoff's equation and the measurements of Berthelot on the heat of combination of oxygen with reduced blood, the variations of the dissociation constant with temperature are calculated.—On a cadmium arsenide: Albert **Granger.** Cadmium, heated in arsenic vapour carried over by hydrogen or an indifferent gas, forms a crystalline arsenide, of composition Cd_3As_2.—The combination of salts of dinaphthopyryl with di-alkylated aromatic amines: R. **Fosse.**—Ethylidene-camphor. Ethyl-homocamphoric acid: J. **Minguin.** A description of the preparation and properties of ethylidene-camphor. It shows a large increase in the rotatory power as compared with the corresponding ethyl-camphor, resembling in this respect the methyl compounds previously described.—On the synthesis of $\alpha\alpha$-dimethylglutaric and $\alpha\alpha$-dimethyladipic acids: G. **Blanc.** The reduction of $\alpha\alpha$-dimethylsuccinic ester by sodium in boiling alcohol gives a glycol, already described, and a lactone. The latter, heated in sealed tubes with potassium cyanide at 270° C., gives dimethylglutaric acid, identical with the acid obtained by the oxidation of isolauronolic acid.—The production of acetylmethylcarbinol by bacteria of the group *Bacillus mesentericus*: Henri **Desmots.** Acetylmethylcarbinol is produced by the action of several varieties of bacilli belonging to the group of *B. mesentericus,* and as this ketonic alcohol can be easily identified by means of its osazone, it may serve as a useful biochemical test.—On mother-of-pearl: Raphael **Dubois.**—The action of the n-rays on the senses, especially on the smell, and on the emission of the n-rays by substances possessing smell: August **Charpentier.** A body emitting the n-rays, when brought near the nose, sensibly increases the intensity of the sensation of smell. Conversely, such substances are capable of

emitting the rays, which can pass through aluminium and show the other properties of the n-rays.—On the pigment of the suprarenal capsules: C. **Gessard.** The chromogen of the suprarenal capsules, in the colourless state which results from the absence of oxygen, is the product of the action of tyrosinase on tyrosine. It becomes coloured on exposure to the air.—The action of the rays given off by phosphorescent calcium sulphide on the lactic fermentation: Charles **Richet.**—The mechanism of the movement of the wing in insects: Lucien **Bull.** It has been shown by Marey that the trajectory described by the end of the wing of an insect is a lemniscate, and has suggested that the deviation from a straight line is due to the resistance of the air. This view is now experimentally confirmed.—On the lignification of the subterranean organs of some plants in Alpine regions: André **Dauphiné.**—On the morphological phenomena of germination, and on the structure of the plantule in palms: C. L. **Gatin.**—On the hibernation of the mildew of the vine: G. **de Istvanffi.**

DIARY OF SOCIETIES.

THURSDAY, MARCH 10.

ROYAL SOCIETY, at 4.30.—On Electric Resistance Thermometry at the Temperature of Boiling Hydrogen: Prof. J. Dewar, F.R.S.—A Study of the Radio-activity of certain Minerals and Mineral Waters: Hon. R. J. Strutt.—Some Uses of Cylindrical Lens-Systems: G. J. Burch, F.R.S.

ROYAL INSTITUTION, at 5.—Electrical Methods of Measuring Temperature: Prof. H. L. Callendar, F.R.S.

MATHEMATICAL SOCIETY, at 5.30.—On Inner Limiting Sets of Points: Dr. E. W. Hobson.—On the Unique Expression of a Quantic of any Order in any Number of Variables with an Application to Binary Perpetuants: Mr. P. W. Wood.—The Derivation of Generalised Bessel Coefficients from a Function Analogous to the Exponential: Rev. F. H. Jackson.—Illustrative Examples of Modes of Decay of Vibratory Motions: Prof. A. E. H. Love.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—The Railway Electrification Problem and its Probable Cost for England and Wales: F. F. Bennett.—The Rated Speed of Electric Motors as affecting the Type to be Employed: H. M. Hobart.

SOCIETY OF ARTS, at 4.30.—China Grass; its Past, Present, and Future: Frank Birdwood.

FRIDAY, MARCH 11.

ROYAL INSTITUTION, at 9.—The Motion of Viscous Substances: Prof. F. T. Trouton, F.R.S.

ROYAL ASTRONOMICAL SOCIETY, at 5.—On the Determination of the Division Errors of a Graduated Circle: S. S. Hough.—On the Degree of Accuracy of the New Lunar Theory: E. W. Brown.—On the Comparison between the Purely Theoretical and Observed Places of the Moon: E. Nevill.—On the Relative Efficiency of Different Methods of Determining Longitudes on Jupiter: A. Stanley Williams.—Positions and Photographic Magnitudes of Ninety Stars surrounding the Variable R Cygni: J. H. Metcalf. Note on the Instrumental Errors affecting Observations of the Moon: H. H. Turner.—Comparisons of the Geocentric Places of the Sun and Major Planets calculated from the Tables of the American Ephemeris Office with their Places calculated from Le Verrier's Tables for 1906: A. M. W. Downing.—Note on the Drawings of the Mare Serenitatis by John Russell, R.A.: S. A. Saunder.—Note on the Date of the Passage of the Vernal Equinox from Taurus into Aries: E. W. Maunder and A. S. D. Maunder.—*Papers promised:* On the Chromatic Correction of Object Glasses, Second Paper: A. E. Conrady.—Note on the Optical Defects of the Microscope of a Measuring Machine for Astronomical Photographs: H. C. Plummer.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Premium System of Payment for Labour: W. G. Banister.

PHYSICAL SOCIETY, at 8.—The Whirling and Transverse Vibrations of Shafts: Dr. C. Chree, F.R.S.—Notes on Non-homocentric Pencils, and the Shadows produced by Them—Part II. Shadows produced by Axially Symmetrical Pencils possessing Spherical Aberration: W. Bennett.

MALACOLOGICAL SOCIETY, at 5.—A *Résumé* of Recent Researches on the Structure of Pelecypod Gills: Dr. W. G. Ridewood.—Descriptions of two new Species of Opisthostoma from Borneo: E. A. Smith. On some Non-Marine Hawaiian Mollusca: C. F. Ancey.—New Species of Mollusca from New Zealand: Rev. W. H. Webster.

SATURDAY, MARCH 12.

ROYAL INSTITUTION, at 3.—The Life and Work of Stokes: Lord Rayleigh.

MONDAY, MARCH 14.

SOCIETY OF ARTS, at 8.—Recent Advances in Electro-Chemistry: Bertram Blount (Cantor Lecture, II).

TUESDAY, MARCH 15.

ROYAL INSTITUTION, at 5.—The Doctrine of Heaven and Hell in Ancient Egypt and the Books of the Underworld: Dr. E. A. Wallis Budge.

ZOOLOGICAL SOCIETY, at 8.30.—Contributions to the Anatomy of the Lacertilia.—I. On the Venous System in certain Lizards: F. E. Beddard, F.R.S.—Note on the Skull and Markings of the Quagga: R. Lydekker, F.R.S.—On Additions to the List of Rhopalocera of Dominica: P. I. Latby.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Barrage across the Nile at Asyut: G. H. Stephens, C.M.G. The Use of Cement Grout at the Delta Barrage in Egypt: Sir R. H. Brown, K.C.M.G.

ROYAL STATISTICAL SOCIETY, at 5.—Statistics of London Traffic: E. J. Harper.

SOCIETY OF ARTS, at 4.30.—Recent Developments in Devonshire Lace Making: Alan S. Cole, C.B.

WEDNESDAY, MARCH 16.

CHEMICAL SOCIETY, at 5.30.—Mercuric Nitrite and its Decomposition by Heat: P. C. Ray.—Note on the Higher Glycerides: J. B. Hannay.—The Nature of a Solution of Iodine in Aqueous Potassium Iodide: C. H. Burgess and D. L. Chapman.—The Reduction of 2:6-Dinitrotoluene with Hydrogen Sulphide: J. B. Cohen and J. Marshall.—Isomeric Change of Diacylanilides into Acylaminoketones. Transformation of the Dibenzoyltoluidines into the Isomeric Benzoylaminotoluophenones: F. D. Chattaway and W. H. Lewis.—Acid Esters of Methyl Substituted Succinic Acids: W. A. Bone, J. J. Sudborough, and I. H. G. Sprankling.—Action of Ethyl β-Iodopropionate on Ethyl Disodioacetylenetetracarboxylate: O. Silberrad.

ENTOMOLOGICAL SOCIETY, at 8.

SOCIETY OF ARTS, at 8.—Artificial and other Building Stones: L. P. Ford.

ROYAL MICROSCOPICAL SOCIETY, at 8.—A Note on Some New Methods of Measuring the Magnifying Power of the Microscope and of Lenses Generally: Prof. A. E. Wright.—Exhibition of Hand-painted Lantern Slides illustrating Botanical Histology prepared by Mr. A. Flatters.

ROYAL METEOROLOGICAL SOCIETY, at 7.30.—Water Vapour: R. H. Curtis.

THURSDAY, MARCH 17.

ROYAL SOCIETY, at 4.30.

LINNEAN SOCIETY, at 8.—On the Bryozoa from Franz Josef Land: A. W. Waters.—Natural-Colour Photographs of Living Insects and Flowers: F. Enock.

AERONAUTICAL SOCIETY, at 8.—Experiments with Aërial Screw Propellers: Major B. F. S. Baden-Powell.—The Beedle Airship: W. Beedle.—Mechanical Flight: Thomas Moy.

INSTITUTION OF MINING AND METALLURGY, at 8.—Annual General Meeting. Followed by Discussion on "The Equipment of Laboratories for Advanced Teaching and Research in the Mineral Industries."

FRIDAY, MARCH 18.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—Compound Locomotives in France: M. Edouard Sauvage.

SATURDAY, MARCH 19.

ROYAL INSTITUTION, at 3.—The Life and Work of Stokes: Lord Rayleigh.

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THURSDAY, MARCH 17, 1904.

NEW WORK IN THE MALAY ARCHIPELAGO.

Reisen in den Molukken, in Ambon, den Uliassern, Seran (Ceram) und Buru. Geologischer Theil. By Prof. K. Martin. Pp. x+296. (Leyden: Successors of E. J. Brill, 1903.)

EVER since Dr. A. R. Wallace revealed the organic treasures of the Malay Archipelago, zoologists have found in this or that island a rich and fascinating field. Following the path indicated by the master-pioneer, they have made these relics of equatorial land serve as a "public park" of philosophical zoology. The geologists, though often appealed to, have been forced to move more slowly, since the very vegetation which preserves the fauna has effectually concealed the junctions of the various types of rock. We have recently (NATURE, vol. lxvii. p. 506) had occasion to discuss the arduous researches of Molengraaff among the forests and water-ways of Borneo. Prof. Martin meets with similar difficulties in the smaller isles of the Moluccas. He remarks that the rivers are often known only by their mouths; and, while he walks across some of the central ridges, he can rarely study what lies to right or left. His maps show what lies along the shore, or on his traverses from coast to coast, and in the case of Buru (p. 215), an island larger than Kent, he has added a good deal to the previously known topography.

Work of this kind has naturally been spread over some years, and the first part of the volume is reprinted from that published in 1897. This might, we think, have been shown upon the title-page, so as to prepare the reader for comments and corrections inserted in the later portion. From p. 49 to p. 54, for example, considerable stress is laid on the recently volcanic character of Wawani, in Amboina, in which Wallace also believed. Prof. Kotô, of Tokio, criticised our author's conclusions so far back as 1899 (*Journ. Coll.* of Science, Tokio, vol. xi. p. 96), and on p. 281 of the present work the supposed evidence of an eruption in 1674 is withdrawn. Some modification of p. 64 also occurs, and the prolongation of the volcanic line of the Talaur Islands and Ternate into Amboina is rejected. So far as the relations of the lines of present eruption and of earth-folding are concerned, we are left, it seems, with Kotô's general map as our most recent guide.

In working out the specimens collected, Prof. Martin has had the help of Dr. Schroeder van der Kolk for the petrography, and of Dr. Rüst for the interesting radiolarian series. The book opens with a description of Amboina and its eastern neighbours, a region occupied more than once by England, and ceded again to Holland as recently as 1814. While largely composed of volcanic material, these islands have been raised above the sea in late Tertiary or Quaternary times. The cracks in the peridotites of Amboina contain modern sandstone with marine remains, while coral-limestone occurs high and dry inland. Even the natives (p. 37) have included this material, with its surface bored and roughened by solution-hollows, under the name "Karang," which they apply to the lower masses so familiar to them along the coast. Here and there only loose blocks remain to prove the former continuity of the reefs across their volcanic basis. "Karang" occurs in the peninsula of Leitimor at a height of 480 metres above the sea. In Saparua (p. 48) there is some evidence of an upward movement at the present day. The main uplift appears, indeed, to have occurred after the reefs had completely buried the earlier masses, since detritus from the latter is not found in the inland "karang."

Prof. Martin believes, moreover, that the eruptions along this east-and-west line were originally submarine, the rapid cooling of the lavas furnishing an unusual amount of glass. In this matter we find an interesting parallel with Mr. Guppy's conclusions as to the Fijis (NATURE, vol. lxix. p. 31). The volcanic rocks consist of various types of andesite and dacite, including at times patches of quartz, cordierite, and garnet, which Dr. Ferdinand von Wolff (p. 102), with great probability, considers to be derived from the cordierite-gneisses that occur among the basal rocks of the Moluccas. Prof. Martin points out (pp. 21 and 93) that the discovery of rolled blocks of gneiss and schist in any given island may be due merely to the carrying up of portions of the old ground in the volcanic masses that broke through it.

The author relies too much on the nature of his igneous rocks in assigning to them a geological age, especially when (p. 37) he determines a radiolarian limestone as Tertiary because it is later than "Neo-volcanic" lavas. This classification was, however, common at the time when he started on his labours. While adding greatly to our knowledge of these rocks, he is able to correct Wallace in regard to Buru, Tomahu, and some other islands, in which he is unable to recognise a volcanic character. Hot springs still arise in Nusalaut, accompanied by deposits of aragonite. The considerable extent of the author's researches is to be seen in Map iii., from Nusalaut to the west of Amboina, where his conjectures are distinguished by shading from the ground actually observed.

The second part of this handsome memoir deals with Seran (Ceram) and the little north-western island of Buano. Ichthyosaurus is already known from Seran, and Prof. Martin regards certain globigerina limestones and flinty deposits as Mesozoic (p. 141). The latter, rich in radiolaria, are probably representatives of Molengraaff's Danau series in Borneo, and also of deep-sea origin. The associated fragments of calcareous algæ may have come from shallower marine banks, and prove nothing as to the nearness of a shore (p. 138).

Besides these fossiliferous deposits, considerable interest attaches to the mica-schist and mica-slate which form the prevalent rocks of the hills of southern Seran, and which at times determine its surface features by their strike. Cordierite occurs both in the schist and in the associated gneiss. A massive "grauwacke" formation represents in part the interval between these rocks and the limestones.

The concluding section describes Buru, an island

lying at the west end of the tectonic line which curves about the Banda Sea. Here again radiolarian flint occurs, as nodules or thin beds in a massive limestone, unconformably overlying "grauwacke." Globigerina beds assist in assigning to this "Buru limestone" a true deep-sea character. Mesozoic molluscan species are known from the later limestones. Typical karang does not seem to have formed freely across the old crystalline rocks of Buru, which remain exposed over a wide area. A consideration of the coast-lines, and of the level nature of the karang formation, leads the author to conclude that the Moluccan region is one of fault blocks and vertical movements (p. 286) rather than of folding. He agrees with Verbeek and with most observers in the Indo-Pacific area that uplift and subsidence of adjacent land masses, and not the retreat of the waters, must be held accountable for the present relations of island-crest and ocean-floor.

A noteworthy feature of Prof. Martin's work is the frequent reference to the soils derived from various types of solid rock. This alone would show the careful spirit in which he has made his observations. As he freely remarks, detail after detail remains to be filled in; but his maps, drawn on a liberal scale, his sections, and the photographic landscapes, give the reader a clear insight into what his journeys have revealed. The Dutch Government, in assisting the publication of the results, has conferred a benefit on geographers as well as on geologists.

GRENVILLE A. J. COLE.

ANOTHER ATTACK UPON DARWINISM.

Mimicry, Selektion, Darwinismus. By M. C. Piepers, Dr. jur. utr. Pp. 452. (Leyden: Brill, 1903.)

THE theory that natural selection is an important if not an all sufficient explanation of the evolution of animals and plants has had to meet the attacks of a few serious and of many frivolous critics. To the former class belongs Dr. Piepers. We may not approve of his methods or agree with his conclusions, but his wide learning, his special knowledge of a single group of animals—the Lepidoptera—and his laborious efforts to disprove the current theories of evolution are sufficient to justify us in classifying him with the serious critics. Many will, doubtless, shrink from the task of reading with care the four hundred pages of closely written text, without illustration, with which his attack is framed and delivered, but every naturalist who has the courage to do so will find in it a great deal of instruction and may we add without offence?—no little amusement. I would suggest to those who attempt the task to disregard, if possible, certain features of the work which disfigure the text.

The denunciation of modern theories with such expressions as the "mimicry humbug," the "heresies of modern biological science" and "phantasies"; the unmannerly denunciation of such naturalists as Weismann, Wallace, Bates and Poulton; the description of the unwholesome character of the English race which produced and encouraged a Darwin (p. 397), are unusual in a work of permanent scientific value. Nevertheless, the pages are filled with many facts bearing upon the theories of mimicry and protective resemblance which will certainly be of value to the serious student of natural history, whatever his preconceived ideas may be.

To quote one of the many interesting facts bearing upon the questions in dispute, we find on p. 22:—

"Ich habe selbst einen meiner javanischen Raupensucher, obwohl er das Thier selbst gefangen hatte, plötzlich erschreckt die Hand zurückziehen sehen, als eine Raupe von Hebomoia glaucippe L. die er mir zeigen wollte, ihre Schlangen-Mimicry annahm, und das wiewohl diese Raupe viel kleiner ist als die der Chaerocampa- und Parechidnia-Arten, die sich mehr der Grösse von kleinen Schlangen nähern, und deren Aehnlichkeit dadurch auch noch viel stärker ist."

It may seem incredible that a naturalist who has had the valuable experience of observing such interesting examples of mimicry as this can doubt the utility to the species of pronounced mimetic resemblance to poisonous or dangerous animals, but Dr. Piepers explains the resemblance in another way, and denies its protective value.

Some years ago Wasmann described a remarkable resemblance between an ant of the genus Eciton and a beetle which dwells in its nest belonging to the genus Mimeciton. If we deny, as Dr. Piepers does, that this is a true case of mimicry, it must be due either to an independent convergence of evolution (homeogenesis) or to a similarity in development caused by a similarity of external influences. But it is impossible to conceive that either of these explanations can account for such a close resemblance, even in the details of the antennæ, as this ant and this beetle exhibit. Surely, as Wasmann remarks, the old theory of special creation is more reasonable than either of these.

At the time the book was written, Dr. Piepers had probably not seen the very remarkable paper by Mr. Shelford on mimetic insects from Borneo and Singapore which was read before the Zoological Society in London on November 4, 1902. In this paper so many examples are given of insects and spiders that closely resemble other insects and spiders with which they associate that the theory of homeogenesis must be strained to the breaking point to account for them. There may be some justice in the remark that the experimental evidence is not sufficient to prove the theory of the origin of mimetic resemblance by natural selection; but what evidence of any kind can be brought to support the theory of homeogenesis, or the startling effects produced in mimicry by similar environments? Absolutely none. The impartial reader must be struck in reading these lengthy theses with the fact that singularly little experimental evidence is related in the text, and none that really supports the truth of any theory but that of natural selection. There is plenty of destructive criticism of current theories, there are many weighty objections and difficulties suggested, but if these succeed in destroying Darwinismus there is nothing left in the way of theory that has any basis of support. But there is a little evidence of a direct nature which our author has overlooked that supports the theory of natural selec-

tion. If he refers to the reports of the British Association for 1898 he will find that Poulton and his assistants have proved that the pupæ of *Vanessa urticae* are subject to a severe struggle for existence from birds at Oxford and the Isle of Wight, and that in this case the resemblance in colour of the pupæ to the surroundings is of prime importance in the struggle.

In the face of such evidence as this the statement on p. 386 that it is pure chance which of the seeds of a tree or which of the eggs of an animal survives requires some better proof than we have at present before it is acceptable. The evidence of Guy Marshall in his valuable papers on the bionomics of South African insects adds very materially to the support of the theory of natural selection, and naturalists may rest assured that, notwithstanding the vigour and the ability with which this, the latest, attack upon their trenches has been delivered, the defence of the theory of natural selection is still intact.

SYDNEY J. HICKSON.

ASSAYING IN THE COLONIES.

Metallurgical Analysis and Assaying. By W. A. Macleod, B.A., B.Sc., A.O.S.M. (N.Z.), and Chas. Walker, F.C.S. Pp. xii+318; with 109 figures in the text. (London: Charles Griffin and Co., Ltd., 1903.) Price 12*s.* 6*d.* net.

THE aim of this work, as explained by the authors in the preface, is to provide a "graded course of work, leading from simple qualitative analysis up to the technical quantitative methods employed by the modern metallurgical chemist," and is intended to cover a period of three years' laboratory work.

The book is divided into three parts, of which part i., containing 50 pages, deals with qualitative analysis and the properties of gases, and part ii., containing 140 pages, deals mainly with quantitative analysis. Part iii., comprising 118 pages, is subdivided into two sections, the first treating of the ordinary methods of fire assaying, while the second gives an outline of the methods employed in some well-chosen examples of technical analyses.

The authors do not claim any originality of matter, but simply novelty in arrangement which is adapted to meet the requirements of students of schools of mines, "more especially of colonial schools of mines." This distinction between colonial and other schools of mines is difficult to understand, for the work which a qualified metallurgical chemist is required to undertake is independent of the locality in which he has received his training, and if the course of study is to be broad and efficient, a text-book which is suitable for one school of mines will be equally suitable for all. At any school of mines the students must be well grounded in the principles of assaying, so that they can understand, test, and practise any method that is subsequently presented to them.

It is obvious, for example, that the study of assaying should be preceded by a course in chemistry, but this can hardly be included amongst the duties of the instructor in assaying. It would be better that the chapters dealing with such subjects as glass working, the preparation and properties of gases, and elementary qualitative analysis should be omitted, and the matter left to the discretion of the professor of chemistry. Moreover, there are so many excellent text-books dealing with this part of the subject that it seems a pity that the authors should have sought to include it in this volume.

Part iii. has been carefully prepared, and the explanations are invariably clear and concise. Unfortunately, however, it suffers from want of space, and might well be expanded at the expense of some of the earlier chapters of the book. Thus the assay of tin ores is dealt with in a chapter of two pages, and that of lead ores occupies only three pages. Silver also receives three pages, and copper, sulphur, and mercury are dismissed in a short chapter of two pages. In spite of this enforced brevity, however, the authors have made the most of the space at their disposal, and the methods they describe are up to date and trustworthy. No pains have been spared in consulting and quoting from the work of recognised authorities on assaying, but it is doubtful whether the frequent reference to divergent opinions may not, in itself, constitute a source of danger. For example, the student who is told that the length of time required for the fusion of a tin assay by the cyanide method is variously estimated by different writers at from 3 to 30 minutes may be tempted to think that he also can vary the time of fusion within these limits, and still obtain satisfactory results. The importance of uniformity in working cannot be too strongly impressed upon the beginner.

The mistakes are remarkably few and unimportant, and the publication of this volume tends to prove that the teaching of metallurgical analysis and assaying in Australia rests in competent hands.

OUR BOOK SHELF.

The Direction of Hair in Animals and Man. By W. Kidd. Pp. xii+154; illustrated. (London: A. and C. Black, 1903.) Price 5*s.* net.

ALTHOUGH it is quite natural that every student should consider his own pet subject one of special importance, we cannot think that Dr. Kidd has sufficient justification for publishing a second work on the hair-slope of mammals, since the volume before us does not appear to carry the case materially further than was done in "Use-Inheritance." Indeed, since the author himself (p. 122) is fain to admit that hair-whorls, featherings, &c. (as he terms the various abnormalities in the direction of the hair) are variable, intrinsically unimportant, and even whimsical, we should have thought that enough had been made of them in the earlier work. If further evidence of their variability and slight morphological importance be considered necessary, we may refer to Prof. Ray Lankester's recent description of the condition existing in two specimens of the okapi, one of which shows a single and the other a double whorl on the forehead. If, however, the author and his publishers find the public sufficiently interested in the subject to absorb a second work, they have, from their own point of view, a sufficient justification for its issue.

Briefly stated, Dr. Kidd's theory appears to be as follows. In certain mammals, notably many long-bodied and short-limbed carnivores, and many rodents, marsu-

pials, marmosets and lemurs, the hair is found to be uniformly directed backwards from head to tail, and downwards from the flanks to the toes. From this presumed primitive condition there are numerous instances of reversal of the direction, accompanied by the aforesaid whorls and featherings at "critical" points, such points being correlated, in many instances at least, with subjacent centres of muscular activity.

Natural selection, it is urged, will not account for these diversities, and we must, therefore, fall back upon habit or use as the inducing cause. This being admitted, it follows, according to Dr. Kidd, that "use-inheritance" is a factor in nature, and consequently that the doctrine of "non-inheritance of acquired characters" is untrue.

The author concludes his argument by asserting that attempts to bring his facts within the domain of natural selection will be ineffectual; and that if any persons are induced to discredit his arguments by the assertion that as Weismann's doctrine holds good in other instances it ought to obtain in the present case, this is not science. With this we leave the case to the judgment of our readers.

We cannot, however, conclude without directing attention to the numerous "misprints" with which Dr. Kidd's work is disfigured, errors that might have been corrected by half-an-hour's visit to the British Museum. To take only the tables on pp. 153 and 154, we find the following errors, viz *jumela* for *jimela*, *Budonas* for *Budorcas*, *jenlaicus* for *jemlaicus*, *senegamus* for *sengamus*, *Œpyceros* for *Æpyceros*, *sömmering* for *soemmerringi*, *madogna* for *Madoqua*, *nalabatus* for *ualabatus*, and *elephus* for *elaphus*. And there is an *erratum*-slip in which not one of these is noted! We may add that the author appears to be unaware of the existence of the name Böocercus for the bongo antelope.

R. L.

South African Flowering Plants. By Prof. G. Henslow. Pp. xii+300. (London: Longmans and Co., 1903.) Price 5*s*.

This book is intended to serve as a guide to students and teachers in South Africa who desire to become acquainted with the more important features of their native flora. Types of the principal orders are described, and instructions given for the practical examination of the different floral structures. The general choice of orders and genera is quite judicious; there are certain omissions, such as Asclepias and Schizoglossum in the Asclepiadeæ, and Helichrysum in the Compositæ, and the inclusion of a larger number of genera, even though only briefly described, would have been advantageous. But regarded as a whole, the systematic portion of the book should fulfil its purpose, and help towards a knowledge of the subject. The introductory chapters are not so satisfactory, for the general account of form and function is weak, occasionally incorrect, and the ecological discussion much too short to enable the reader to comprehend the very many striking peculiarities which characterise the flora of the country. And in the chapter on the structure of the flower the author has presented a dull and mechanical treatment of what might be made an extremely interesting subject if taken from the developmental point of view.

Die Bildnis-Photographie. Ein Wegweiser für Fachmänner und Liebhaber. By Fritz Loescher. Pp. xii+180; mit 98 Abbildungen. (Berlin: Gustav Schmidt, 1903.) Price 4.50 marks.

The author confines himself solely to portrait photography in this book, and a very complete treatise he has given us on the subject. Commencing with a brief historical sketch of the early methods of portraiture from the daguerreotype to the silver bromide gelatine dry plate, on which he makes interesting comments, he then passes through the intermediate stages and describes the modern methods. The next chapter is devoted to the necessary instrumental equipment of a modern studio. This is followed by two chapters on portraiture in-doors and out-of-doors, another on working accessories, such as furniture, backgrounds, &c., and the last two on the production of the negative and positive.

Throughout the book the author has given a clear straightforward account of the various methods of procedure and has illustrated his remarks in a great number of cases by appropriate reproductions; in fact the illustrations form a distinctive feature of the book.

Those who make a speciality of portraiture and who can read German will, no doubt, find many useful wrinkles in these pages, for the author has taken advantage of the various methods practised in different countries and expounded them in their appropriate places.

Descriptive Chemistry. Parts i. and ii. By Lyman C. Newell, Ph.D. Pp. vi+488+135. (London: Heath and Co., 1904.) Prices 4*s*. 6*d*. and 1*s*. 6*d*.

One feels a certain amount of diffidence in reviewing a book which, either in the MS. or proof, has passed through the hands (so the preface states) of no less than eight distinguished American professors and teachers of chemistry, but the task is fortunately simplified by finding that the volume, with its small "experimental" companion, is written for teachers and not beginners.

One looks, therefore, more to the manner than to the matter of the book, but there is nothing in either the one or the other which seems to call for special comment. It is a conscientious, uninspired performance. It contains the usual information found in an elementary text-book presented in the usual form, with scraps of organic and physical chemistry, fragments of history, and a description of modern electrolytic processes. It is therefore well up to date, and as an *aide-mémoire* for the teacher is quite trustworthy, provided he expands and vitalises what is dull or unconvincing in the explanatory matter. The illustrations, though not numerous, are good. The picture of a platinum dish might be omitted as superfluous, and the illustration of calcite crystals might do very well for cleavage fragments, but does not represent the familiar forms of the mineral.

The American writers on elementary chemistry have not yet reached the level of their writers on nature-study, and the present volume seems to emphasise the fact that there is still room for a good chemistry for teachers.

J. B. C.

Onde hertziane e Telegrafo senza Fili. By Oreste Murani. Pp. 341; with 172 woodcuts. (Milan: Ulrico Hoepli, 1903.)

This is one of the Manueli Hoepli, and, in uniformity with other books of the same series, is of pocket size. In it Prof. Murani has endeavoured to bring some general knowledge as to the nature of wireless telegraphy within reach of those who start with no previous knowledge of electricity. Accordingly, we find in the earlier chapters figures of the proof-plane, the gold-leaf electroscope, the ice-pail, the frog's leg, the crown of cups and Ampère's swimmer, much as they used to figure in the text-books of our youth. The difference of the present book from these old handbooks is evident when we come to electric oscillations, Wehnelt interrupters, and ships with antennæ to their masts. The last two pages give a short biography of Mr. Marconi.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* Nature. *No notice is taken of anonymous communications.*]

Radio-tellurium.

In an article in the issue of Nature for February 11 Mr. F. Soddy gave some account of certain of the results of my investigations with regard to radio-tellurium. In this he criticised somewhat severely my choice of a name for the radio-active substance. He holds the substance investigated by me to be identical with polonium, and even goes farther than Madame Curie herself, who, in her recently published "Dissertation," characterises the use of a new name for the substance as premature.

In a paper published by me in the *Berichte der deutschen chemischen Gesellschaft* in September last, I have already given the reasons which have induced me to propose the name radio-tellurium "provisionally" (vorläufig). Mr. Soddy has not discussed these reasons, although he has had the opportunity of making himself acquainted with my communication before writing his criticism. As the question has once been raised before the readers of Nature, however, it might be of advantage to discuss it here somewhat more fully.

Shortly after the discovery of polonium by M. and Madame Curie, Giesel found that this substance quickly lost its radio-activity, and he characterised it therefore as inducedly active bismuth. P. and S. Curie themselves had, indeed, shortly before the publication of my first paper on the subject, defined polonium as "une espèce de bismut actif." The observations of Giesel and the Curies differ from one another on two points. Giesel's polonium emitted α and β rays and lost its activity within a few weeks, while that of the Curies sent out only α rays, and lost the greater part of its activity only after the lapse of a few months. More recently Giesel has shown that bismuth by prolonged immersion in a solution of pure radium bromide can become permanently (?) active, and then emits only α rays.

Hence there exists with certainty an inducedly active bismuth giving out only α rays, and this might with accuracy be called polonium. There exists, further, a bismuth giving out α and β rays—Giesel's polonium. In this I have found traces of radio-tellurium, and I have shown that after the removal of the latter the remaining substance shows strong β and diminished α radiations. Finally, after the discovery of radio-tellurium, Madame Curie has purified her polonium by fractional precipitation of the subnitrate, and has ultimately arrived at a substance, of which she describes precipitates, the properties of which agree neither with those of bismuth nor with those of radio-tellurium. This substance she calls polonium. It can be seen from this brief summary that the idea associated with the name polonium is an extremely variable and indeterminate one.

In the investigation of bismuth separated from Joachimsthal pitchblende in an essentially different way from Madame Curie,[1] I found a small quantity of tellurium which was extraordinarily active. From one kilogram of bismuth I was able to separate only about a tenth of a gram of tellurium. This had not previously been found in the pitchblende.

Since the substance was distinguished from ordinary tellurium at first only by its radio-activity, I named it radio-tellurium "provisionally." To give a final name to it seemed to me to be premature. The example of polonium showed clearly enough the confusion arising from giving a permanent name to a thing before the thing itself has been accurately defined. Hence Madame Curie can least of all afford to reproach me with being too hasty in my naming.

The further investigation of radio-tellurium showed how necessary was my caution, for it proved that the substance consisted mainly of ordinary tellurium. It was possible, however, to separate, in a quantity amounting at most to a few tenths of 1 per cent., a radio-active substance of extremely high activity in proportion to its quantity. This substance, of which up to the present I possess only a few milligrams, I have named radio-tellurium "provisionally." Ought I, as Mr. Soddy seems to suggest, to call it also polonium, and so increase the present confusion?

Mr. Soddy appears to wish the justification for a new name to depend on the proof of the constancy of radio-activity of my substance. This suggestion of Mr. Soddy's was not necessary to induce me to pursue experiments in this direction. Such are already undertaken in the most accurate manner, but their results, which must be waited for, have not the least to do with the question of nomenclature. The name polonium does not denote a particular substance which has the property of losing its radio-activity with the course of time—who could at present be sure of the constancy of activity of radium?—but merely radio-active bismuth. So far as the constancy of the radio-tellurium emission is concerned, I may here cite the following experiment. A copper plate of about 8 square cm. surface, on which not more than a few hundredths of a milligram of the purest radio-tellurium have been precipitated, now, after nine months, radiates so powerfully that the phosphorescence of zinc blende and of barium platinocyanide can be made visible to an audience of several hundred people.

Mr. Soddy has thought fit towards the close of his article to attribute to certain German organic chemists the custom of "rechristening well-known bodies." In a way that can hardly be misunderstood, he insinuates that this may be traced to an endeavour to claim for themselves the discoveries of others.

This somewhat objectionable charge Mr. Soddy has in no way shown to be grounded. Polonium can, indeed, hardly be reckoned as one of the well-known bodies.

I can also the more easily refrain from answering this aspersion as I am aware that some of the most prominent English chemists have a quite different opinion of their German colleagues from that of Mr. Soddy. I would recommend in this direction a perusal of Prof. P. F. Frankland's address to the chemical section of the British Association in 1901.

W. Marckwald.

[1] Madame Curie has recently published her method of separation. I separated the bismuth from the pitchblende by precipitating it as oxychloride by the addition of much water to the hydrochloric acid solution.

Prof. Marckwald's communication will probably be welcomed by the scientific world on account of the opportunity it affords of settling finally the disputed question as to the nature of the body named by him "radio-tellurium." In my own mind, before I had read Prof. Marckwald's letter, a doubt still lingered as to the identity of the body with Madame Curie's polonium on account of the very definite statement made by Prof. Marckwald in his first communication on the subject that the activity of his body did not decay with the time. This to me was an insuperable difficulty in the way of considering the two bodies to be identical. The other reasons Prof. Marckwald has advanced—and it is not likely I should have ventured to express an opinion without having made myself acquainted with these reasons—seemed to arise out of a misconception on the part of Prof. Marckwald himself as to the nature of polonium. This point I hope to discuss later, but first I wish to deal with the, to me, important question of the constancy of the radio-activity of radio-tellurium. It is satisfactory to learn that accurate determinations are in progress. Everyone will understand that the results must be waited for. What I did not appreciate before reading Prof. Marckwald's letter was that his conclusion that the activity of radio-tellurium did not decay with time was merely an impression unsupported by actual measurements.

The experiment quoted, that a sample of radio-tellurium after nine months still illuminates a phosphorescent screen brightly, would seem to illustrate my point that Prof. Marckwald even now seems to be under a misapprehension as to the nature of polonium. After nine months, polonium, according to the work of its discoverer, would still possess at least one-half of its initial activity. I suppose no one would maintain that it is possible to remember over a period of nine months the various degrees of luminosity, produced by a radio-active preparation, with sufficient accuracy to be sure of a diminution by one-half of the initial luminosity during that interval. In two or three years the decay of activity of polonium should

be obvious even with this rough test, but it certainly would not be sufficiently marked in nine months. We may therefore take it as settled that there is absolutely no evidence at the present time for supposing that radio-tellurium possesses a more constant radio-activity than polonium. If only this point has been made clear this correspondence may be considered to have justified itself.

According to Prof. Marckwald the idea associated with the term polonium is an extremely variable and indeterminate one. It seems to me that this is to put a wrong valuation on the work of its discoverer. Madame Curie gave the name to the hypothetical constituent of the bismuth separated from Joachimsthal pitchblende which caused its radio-activity. The radio-activity in question is distinct from that of any known radio-active substance, for it comprises only the emission of the α or non-penetrating type of radiation. Moreover, it slowly decays with time, and diminishes to half the initial value in about a year. Madame Curie has always been careful to point out that she has not succeeded in separating polonium from bismuth, or in obtaining any spectroscopic or other more direct proof of its existence. The name polonium applies to the body *causing this particular kind of radio-activity*. Hundreds of workers, I suppose, have obtained from the Société de Produits Chimique de Paris specimens of polonium prepared by Madame Curie's method, and have satisfied themselves by their own observations as to the character of its radio-activity. Now Prof. Marckwald has never claimed that he has isolated his body radio-tellurium, although he has been more fortunate than Madame Curie in effecting its concentration. Hence the name radio-tellurium applies also to the hypothetical constituent causing the radio-activity rather than to the preparation itself. Many, no doubt, have obtained also specimens of radio-tellurium from the firm of Dr. Sthamer, of Hamburg, and have compared its properties with those of polonium.

The meaning applied by Prof. Marckwald to the word polonium may be illustrated by these sentences quoted from his letter. "Shortly after the discovery of polonium Giesel found that this substance quickly lost its radio-activity. . . ." "Giesel's polonium emitted α and β rays and lost its activity within a few weeks." "In this (Giesel's polonium) I have found traces of radio-tellurium, and I have shown that after the removal of the latter the remaining substance shows strong β and diminished α radiation."

The question at issue is therefore a very simple one. Is Prof. Marckwald justified in applying Madame Curie's name to Prof. Giesel's preparation? "Giesel's polonium," according to Prof. Marckwald's statement, is a mixture of two radio-active constituents:—(1) radio-tellurium, (2) a constituent giving β as well as α rays. The latter, since it can neither have been polonium nor radio-tellurium, need not be further considered in the present discussion. It *may* be something new and interesting, but, on the other hand, there is nothing to show that it was not merely a trace of radium present as an impurity. In either case it does not concern us, and two bodies only, Madame Curie's polonium and Prof. Marckwald's radio-tellurium, need be further considered. Both are obtained from the same variety of pitchblende, both are distinguished from all the other radio-elements by the fact that they only give α rays, and both possess at least a considerable fraction of their initial activity after the lapse of one year. Now Prof. Marckwald used the same[1] raw material as Madame Curie, namely, the bismuth extracted from the Joachimsthal pitchblende. Since he states that his method separated *all* the active constituent we may feel certain (1) that radio-tellurium must certainly contain polonium; (2) that as it gives no β rays it contains none other of the known radio-active elements; (3) that as the radio-active properties of the two preparations are indistinguishable the active constituent of Prof. Marckwald's preparation is the same as that of Madame Curie's preparation, and therefore by every recognised canon should be termed polonium.

Prof. Marckwald's work has shown that there are present on a maximum estimate 4 milligrams of the active constituent in two tons of pitchblende, or in 8 kilograms of the bismuth salt separated from it. Hence what possible bearing can such a small trace of substance have upon the analytical reactions of the relatively vast bulk of the raw material? In laying stress on these reactions he frequently seems to apply the term polonium to Madame Curie's preparation rather than to its radio-active constituent.

The same criticism might be applied to the following sentence, to be found in his most recent communication (*Berichte*, 1903, p. 2665). "Whether this Curie's polonium does not perhaps contain also some radio-tellurium is a question which must be left to the discoverers of polonium."

With regard to the view expressed that polonium is merely radio-active bismuth, or inducedly active bismuth, in support of which an opinion once expressed by Madame Curie is quoted, the answer, of course, is that Prof. Marckwald's own subsequent work has shown otherwise. By the experiment of depositing on a stick of pure bismuth the whole of the polonium present in a solution, he makes it evident that the latter cannot be bismuth. Those who are acquainted with the work of Rutherford in 1900 on "induced" activity know that the whole conception of radio-active induction has been built up on a simple misconception of the phenomena it is designed to explain. The conception had its origin in the belief that the *rays* from a radio-active substance could excite radio-activity in otherwise inactive matter, which was not in accordance with the facts known at the time it was put forward.

Giesel repeated the identical experiment of Prof. Marckwald with a solution of pure radium, and found that a stick of bismuth after immersion becomes permanently (?) active and then only emits α rays, and Prof. Marckwald, in spite of his own work, concludes that there exists with certainty an inducedly active bismuth giving only α rays, which might with accuracy be termed polonium. He, however, omitted to state that Giesel obtained the identical result if a stick of platinum or palladium were immersed in the radium solution. Hence it might be argued that there exist an inducedly active platinum and an inducedly active palladium, both of which might with accuracy be termed polonium. The alchemists considered that they had turned iron into copper by means of a solution of blue vitriol, until it was pointed out that the latter substance contains copper. It has never been shown that any of the effects of the so-called "radio-active induction" are really due to the conversion of an inactive element into radio-active matter. From the existing evidence to the contrary, it would seem more reasonable to suppose that they admit of a similar interpretation to that now adopted to explain the cuprification of iron.

FREDERICK SODDY.

[1] The point raised in the footnote to Prof. Marckwald's letter is, I take it, a side issue. He brings forward no evidence that the bismuth separated from the pitchblende by sulphuretted hydrogen (Curie) is different in its radio-active properties from that separated by himself as oxychloride, nor any reason for supposing that the active constituent in the two cases might be expected to be different. It is true that his bismuth contained a minute proportion of ordinary inactive tellurium, which was probably almost or quite absent in Madame Curie's preparation. This fact he made use of as the basis of his elegant method of concentrating the active constituent, and he seems to have at first confused the difference of behaviour of the two raw materials to differences in the chemical nature of the active constituents rather than to the fortuitous presence of a trace of tellurium. But his own later experiments (*Berichte*, 1903, p. 26[illegible]3) show that when the tellurium is removed from the solution his methods of precipitating the active constituent completely fail, but again work perfectly if a few tenths of a milligram of ordinary telluric acid in aqueous solution are added.

Dependence of the Ionisation, produced by Röntgen Rays, upon the Type of the Rays.

MR. EVE, in his letter in NATURE of March 10 (p. 436), shows that the relative amount of ionisation produced by Röntgen rays in different gases depends upon the "hardness" or penetrating power of the rays. I have lately been investigating this question of the dependence of the relative ionisation upon the type of rays, and an abstract of a preliminary paper on the subject appeared in a report of the proceedings of the Cambridge Philosophical Society in the number of NATURE issued on February 18 (p. 383). These experiments, along with later ones, show that the relative ionisation in different gases depends upon the type of rays used. I used a balance method, balancing the ionisation in each gas against that in air. The pressure of the gas in the Röntgen ray bulb was varied, thereby varying the "hardness" of the rays, and it was found that in the case of gases in which the ionisation is greater than in air the ionisation in these gases decreases relatively to that in air

as the rays become harder. This result is in agreement with that given by Mr. Eve. I find also that in hydrogen, in which the ionisation is much less than in air, the ionisation increases relatively to that in air with the increase of hardness of the rays.

The experiments are not quite completed yet, but it is hoped to publish a full account of them shortly.

R. K. McCLUNG.

Cavendish Laboratory, Cambridge, March 12.

Polarisation in Röntgen Rays.

IN a paper on secondary radiation from gases subject to X-rays (*Phil. Mag.* [6] v., p. 685, 1903), I described experiments which led to the conclusion that this radiation is due to what may be called a scattering of the primary X-rays by the corpuscles (or electrons) constituting the molecules of the gas. More recently I have found that from light solids which emit a secondary radiation differing little from the primary, the energy of this radiation follows accurately the same law as was found for gases, so that the energy of secondary radiation from gases or light solids situated in a beam of Röntgen radiation of definite intensity is proportional merely to the quantity of matter through which the radiation passes. Experimental evidence points to a similar conclusion even when metals which emit a secondary radiation differing enormously from the primary are used as radiators, though I have as yet only shown that the order of magnitude is the same in these cases. The conclusion as to the origin of this radiation is therefore equally applicable to light solids, and probably to the heavier metals.

As explained by Prof. J. J. Thomson ("Conduction of Electricity through Gases," p. 268), on the hypothesis that Röntgen rays consist of a succession of electromagnetic pulses in the ether, each ion in the medium has its motion accelerated by the intense electric fields in these pulses, and consequently is the origin of a secondary radiation, which is most intense in the direction perpendicular to that of acceleration of the ion, and vanishes in the direction of that acceleration. The direction of electric intensity at a point in a secondary pulse is perpendicular to the line joining this point and the origin of the pulse, and is in the plane passing through the direction of acceleration of the ion.

If, then, a secondary beam be studied, the direction of propagation of which is perpendicular to that of the primary, it will on this theory be plane polarised, the direction of electric intensity being parallel to the pulse front in the primary beam.

If the primary beam be plane polarised, then the secondary radiation from the charged corpuscles or electrons has a maximum intensity in a direction perpendicular to that of electric displacement in the primary beam, and zero intensity in the direction of electric displacement. Prof. Wilberforce first suggested to me the idea of producing a plane polarised beam by a secondary radiator, and of testing the polarisation by a tertiary radiator.

The secondary radiation from gases is, however, much too feeble to attempt the measurement of a tertiary. From solids I think it will be possible, and hope shortly to make experiments on this.

It occurred to me, however, that as Röntgen radiation is produced in a bulb by a directed stream of electrons, there is probably at the antikathode a greater acceleration along the line of propagation of the kathode rays than in a direction at right angles; consequently, if a beam of X-rays proceeding in a direction perpendicular to that of the kathode stream be studied, it should show greater electric intensity parallel to the stream than in a direction at right angles.

I therefore used such a beam as the primary radiation, and studied by means of an electroscope the intensity of secondary radiation proceeding from a sheet of paper in a direction perpendicular to that of propagation of the primary beam.

By turning the bulb round the axis of the primary beam studied, the intensity of this beam was not altered, but the intensity of the secondary beam was found to reach a maximum when the direction of the kathode stream was perpendicular to that of propagation of the secondary beam, and a minimum when these two were parallel.

In one series of experiments the intensity of secondary radiation in a direction perpendicular to that of the primary beam was compared with that in a direction making a small angle with the axis of the primary beam. The latter, according to theory, should not vary with the position of the X-ray bulb.

In a second series of experiments the intensity of secondary radiation in a direction perpendicular to the axis of the primary beam was compared with that of a small portion of the primary beam itself, when the bulb was in different positions.

Lastly, the intensity of secondary radiation was measured in two directions perpendicular to that of propagation of the primary radiation and perpendicular to each other, while the intensity of the primary beam was measured by a third electroscope.

The three methods gave similar results.

In the last case, as the bulb was turned round as described, one secondary beam reached a maximum of intensity when that at right angles attained a minimum. When the bulb was turned through a right angle the former produced a minimum of ionisation while the latter produced a maximum.

Two bulbs were used and the sizes of the apertures were varied, but the results were similar in all cases.

The variation of intensity of the secondary beam amounted to about 15 per cent. of its value, but this, of course, does not represent the true difference, as beams of considerable cross section were studied, consequently secondary rays making a considerable angle with the normal to the direction of propagation of the primary rays were admitted into the electroscope.

The experiments are being continued.

These results, however, are in agreement with the theory, and I think show conclusively that the X-radiation proceeding from a bulb is partially polarised.

CHARLES G. BARKLA.

University of Liverpool, March 10.

The British Government and Marine Biology.

IN a note in your issue of February 25 announcing the appointment of Mr. James Hornell, who, it is stated, acted as Prof. Herdman's assistant during the Ceylon pearl oyster investigation, to the post of marine biologist to the Government of Ceylon and inspector of the pearl banks, it is said that "the appointment is of interest as showing how in the recognition of science some of our colonies are in advance of the mother country. We have no 'marine biologist to the Government' here."

Now although the latter statement may be verbally accurate, it appears to me to be misleading, and one would seem to be justified in supposing that it has been made without full knowledge of the facts.

At the present time the British Government is committed to an expenditure of 42,000*l.*, to be spread over a period of three years, for the purpose of carrying out the British portion of the international fishery investigations, the programme of which, conceived in an eminently scientific spirit, has been drawn up by an international council comprising amongst its members some of the most distinguished of European marine biologists. In addition to this the Government has made for a number of years, and still continues to make, a grant of 1000*l.* a year to the Marine Biological Association, the declared object of which is the promotion of both scientific and economic marine biology; public money has been spent on scientific fishery investigations in both Scotland and Ireland, and the Government has quite recently appointed Dr. A. T. Masterman, a well known and capable marine biologist, to the post of inspector of fisheries.

To decline to acknowledge what is already being done is surely not the way to obtain increased support for scientific investigations in the future.

E. J. ALLEN.

Marine Laboratory, Plymouth.

THE brief statement contained in the note was quite correct, and although it might be expanded and illustrated, it needs no qualification. We were well aware of all the facts stated by Dr. Allen.

The fact that the British Government has given a considerable grant for a limited and short period in order to meet part of the expense of an international fishery investigation does not, unfortunately, enable us to claim that we have a "marine biologist to the Government." The Government gives various grants to enable special pieces of scientific work to be carried out, but that does not constitute the recipients Government officials.

Dr. Allen reminds us that a marine biologist has been recently appointed inspector of fisheries. Fortunately that is no new thing. The list in the past includes Huxley and Frank Buckland, and we hope that all our inspectors of fisheries are competent biologists—but they are H.M.'s "Inspectors of Fisheries."

The Government grant to the Marine Biological Association goes to no Government official. The cover of the current number of the *Journal* of the Marine Biological Association announces that "The Association owes its existence and its present satisfactory condition to a combination of scientific naturalists, and of gentlemen who, from philanthropic or practical reasons, are specially interested in the great sea-fisheries of the United Kingdom." This is no Government institution.

One of the conditions attached to the annual grant from the Treasury was that space at the Plymouth Laboratory should be placed at the disposal of any competent investigator deputed to carry out investigations into fishery questions. None of the Government fishery departments (England, Scotland, Ireland) have, however, availed themselves of this condition. Where, then, is the "Government marine biologist"?

The Writer of the Note.

Learned and Unlearned Societies.

Mr. Basset's letter (p. 437) is of importance in giving authoritative evidence of what goes on behind the scenes. It was only a matter of suspicion with me that the benevolent rejectors sometimes knew even less about the subjects of the papers than the authors themselves. But the remedy proposed by Mr. Basset is, I fear, a very unsatisfactory one. Just the same sort of thing can and does occur elsewhere. The only right and proper course seems to be that indicated by Mr. Buchanan. It would be enormously to the advantage of an old-established institution, and to its members, even though there might sometimes be some counteraction by the admission of poor matter. But it is not necessary to repeat here Mr. Buchanan's argument, which was very strong and full of common sense.

Oliver Heaviside.

March 13.

A Plea for Good English.

I believe the phrase that "language was given us to conceal our thoughts" only holds good in diplomacy, and it may therefore be reasonably expected that a professor of science should endeavour to teach his pupils to express themselves in clear, concise and literary English. The German language lends itself to a process known as word-building, and for aught I know to the contrary, the word "Schwefelkohlenstoff" may be good, literary German. But this process is altogether foreign to the genius of the English language, and I cannot imagine a more barbaric or misleading conglomeration of verbiage than the phrase "chalk-stuff-gas." Chalk is popularly associated with lime, or, to speak more accurately, with calcium, and to call a substance "chalk-stuff-gas" which does not contain an atom of calcium appears to me a misuse of language, especially as CO_2 can be prepared in various ways without using any substance containing calcium, or what is popularly known as "chalk" or "lime." It seems to me that it would be difficult to invent a more suitable phrase than "carbon dioxide," since it expresses in terse and pointed language the chemical composition of the gas.

Alassio, March 9.

A. B. Basset.

Zoological Nomenclature.

On p. 200 of your issue of December 31, 1903, just arrived, in a review by "W. T. B." I note an allusion to my "curious illustrations of zoological nomenclature," and it is stated that my "new name" (which, by the way, was proposed in 1899!) "is given to a genus the type of which appears, according to the rules of Linnæus himself, to be also the type of the Linnæan genus Cimex."

Where, sir, are these "rules of Linnæus himself" in which the fixation of types is set forth? I was under the impression that we were indebted to Fabricius for these indispensable aids to zoological nomenclature, and I would be grateful for the reference to Linnæus.

Your reviewer's remark on Cimex contains an error; "lectularius" is not and cannot be the type of Cimex, Linn., (1) because it does not conform to the description of that genus as set forth by the founder. Moreover, if the type be worked out historically, "lectularius" is equally invalid; the first discerptor was Fabricius, who, in a perfectly straightforward manner, removed our species from Cimex to form a part of his new genus Acanthia. This effectively prevents lectularius from ever appearing as the type of Cimex, and it is a fact well known to the students of the Rhynchota.

Further, lest it might be thought that the proper generic name of lectularius is Acanthia, let me mention that in 1797 Latreille restricted the latter to "littoralis" and its congeners, and "lectularius" was again shut out, the way that, so far as my knowledge then went, I was justified in proposing a new name. However, since then I have acquired a somewhat rare book, the "Hemiptera Sueciæ" (1829), the authorship of which is usually ascribed to Fallén, but is mentioned as Johannes Petersson for p. 141, where "Clinocoris" is proposed, and I willingly, and, indeed, inevitably, retire in favour of this for the unfortunate and so long homeless "bed-bug." My previous ignorance of this was shared apparently by everyone since the first announcement of the name (as applied to lectularius).

With regard to the "curious illustrations of zoological nomenclature," I would refer "W. T. B." to the witty and able "Zoological Nomenclature. Remarks on the Proposed International Code," by T. R. R. Stebbing, in the *Zoologist* for October 15, 1898, 2, pp. 423–8. As the reverend karkinologist remarks, "no possible harm is done if we do leave to the polished scholar some little occasion for chuckling over us untutored sons of science."

G. W. Kirkaldy.

Department of Agriculture, Honolulu, H.I., January 26.

Mr. Kirkaldy's remarks about the type of the Linnæan genus Cimex are a quibble, to which it is sufficient reply to point out that in the passage which he quotes and attempts to ridicule it was not stated that *Cimex lectularius* was made the type of the genus by Linnæus.

Although the selection of one species of each genus as the type is of later date than Linnæus, several of the Linnæan genera are clearly founded on a particular species in each case. Thus, to take familiar forms, Equus is named from the horse, and it is therefore correct to say that *E. caballus* is the type of the Linnæan genus Equus. Similarly *Bos taurus* is the type of Bos, and *Canis familiaris* of Canis. Similar cases are rare amongst invertebrate animals, but Cimex is an exception, for the generic name was taken from a species in the Linnæan genus that was called Cimex in classical Latin. The only species that can be clearly identified with the Latin name appears to be *C. lectularius*, Linn.

This, however, has been disputed—what opinion has not?—by a few amongst the very many writers who have treated the question of Cimex and Acanthia, so another reason may be given for regarding *C. lectularius* as the type of Cimex. The rule of Linnæus, quoted below, was that if a genus be divided, the commonest and best known species should be retained under the original generic name. There can be no question that *C. lectularius* is by far the best known species of the genus.

The "rules of Linnæus himself" were printed in his "Philosophia Botanica," and quoted by Agassiz in the introduction to the "Nomenclator Zoologicus." These rules have always been regarded as authoritative by both botanists and zoologists, and should in any case be consulted when Linnæan genera and species are concerned. The two following rules apply in the present case:—

242. *Nomen genericum* Antiquum *antiquo generi convenit.*

246. *Si genus receptum, secundum jus naturae et artis*

in plura dirimi *debet, tum nomen antea* commune *manebit* vulgatissimæ *et officinali plantae.*

It must be evident that when Fabricius removed *Cimex lectularius* from Cimex and placed it in a new genus Acanthia, he disregarded the rules of Linnæus, and his classification in this instance was rejected by Latreille and by many later writers. What would be thought of a naturalist who proposed to remove the dog from the Linnæan genus Canis, and to retain that generic name for the hyæna, which was included in the genus by Linnæus? According to Mr. Kirkaldy's contention this is the nomenclature we should be bound to adopt by the "rule of priority" if the individual who proposed the absurdity happened to be the first to divide the original genus.

Mr. Kirkaldy has not pointed out in what respect *C. lectularius* does not conform to the description of the genus Cimex as set forth by the founder. He probably refers to the mention of four wings amongst the generic characters, *C. lectularius* being apterous or nearly so. The objection is invalid in view of the facts already stated, and of the inclusion of the species in the genus by Linnæus, who prominently recorded the absence of wings in this case.

The subordinate question as to the type of Acanthia has been discussed *ad nauseam.* Anyone who feels interested in the matter will find a full history by Reuter in the *Wiener Entomologische Zeitung*, vol. i., 1882, p. 301. By an argument rather different from that above given, Reuter came to the same conclusion as to the type of Cimex. Mr. Kirkaldy's last proposal, to use Clinocoris for *C. lectularius,* is a curious illustration of his method. Clinocoris was suggested in the "Hemiptera Sueciæ" as a name to be substituted for the Fabrician Acanthia, because "*forsan convenientius judicabitur nomen Clinocoris.*" But this substitution of one name for another on the score of convenience is absolutely in defiance of the "rule of priority."

W. T. B.

Spawning of the Plaice.

THE plaice (*Pleuronectes platessa*) in the open-air pond at the Port Erin Biological Station started spawning on March 3, and those at the Piel (Lancashire) Sea-Fish Hatchery (under cover) on March 1. This is about a week earlier than last year (March 9). It would be interesting to know how this record compares with that of fish in the sea. At the time of writing I have no returns that will give the information for the Irish Sea, though I hope to know later. Probably the officials of the International Investigation will be able to speak of the condition in the North Sea, and those of the Plymouth Biological Station in regard to the English Channel. W. A. HERDMAN.

Liverpool, March 8.

Preliminary Measurement of the Short Wave-lengths discovered by Schumann.

FOR the past few years the writer has been engaged in an attempt to measure the short wave-lengths discovered by Dr. Victor Schumann, and very recently the attempt has proved successful.

Working in an atmosphere of hydrogen with a concave grating ruled on speculum metal, an "end-on" tube filled with hydrogen gives numerous lines below the aluminium group at 1854 Ångström units.

The shortest of these wave-lengths so far observed by the writer has a value 1206 Ångström units. Thus the measurable spectrum has been extended by 648 units.

It is interesting to note that, contrary to expectation, speculum metal is able to reflect these very short wave-lengths to a considerable degree.

The writer has in preparation a complete list of the new wave-lengths. He has also good hopes of still further extending the spectrum. THEODORE LYMAN.

Jefferson Physical Laboratory, Harvard University, February 29.

Women and Sanitary Science.

IN your issue of February 11 a reference was made to a recent report of the Subcommittee on Technical Instruction for Women appointed by the Technical Education Board of the London County Council, quoting one of the recommendations of the committee that "Classes be established for the training of women in hygiene and sanitation with a view to their taking up the occupation of sanitary, workshop or public health inspectors, or of rent collectors."

May I urge in this connection the great importance of all training in hygiene and sanitation being thoroughly scientific in character and based upon practical teaching in chemistry, physics, physiology, and bacteriology?

"Hygiene," to quote Dr. T. M. Legge, H.M. Medical Inspector of Factories, "is not a science in itself, but is the meeting point where several exact sciences widely distinct from each other meet and yield up that element they possess which can be of practical use in the prevention of disease and the preservation of health."

At every turn the inspector or health worker is brought face to face with facts which can only be appreciated in their true light by a person who has had some considerable scientific training, and the greater their scientific knowledge the more enlightened and efficient will their work be.

Bedford College in 1895 established a scientific course in hygiene for women. While amply providing for the necessary practical demonstrations in hygiene proper, we continue to attach great importance to laboratory work in chemistry, physics, physiology, and bacteriology, as we believe the latter to be essential to a thorough teaching of hygiene, and necessary if women are to have a first-hand knowledge of the subject and become intelligent and effective workers. ETHEL HURLBATT.

Bedford College for Women, York Place, Baker Street, W.

Aërial Tubers on the Potato.

I DO not know whether the appearance of tubers on the stems of potatoes as well as underground is a frequent occurrence, but last season I noticed several plants presenting this appearance. One of the plants had a large number of underground tubers as well as those appearing above ground. The abnormal tubers were purple in colour; each one had several "eyes," and one or two minute green leaves showed in each "eye." The garden is a very stiff clay. The season was very wet as the potatoes were maturing; in fact, the ground was too soft to allow of digging at the proper time. My explanation is that the great quantity of water on the ground destroyed the balance between producing power in the leaves and storage power in the normal tubers, and that the surplus production deposited itself in the stems, which at the selected spots became modified tubers. W. TRAYLEN.

Guildford, Western Australia, January 28.

THE appearance of tubers on the haulm in the axils of the leaves is not uncommon, and as the bud and the tuber are homologous, the circumstance is only what might be expected.

In this country it is generally considered that some injury to the subterranean part of the plant, as by the spade or fork, or perhaps by wire worm or other destructive insect, is the inducing cause of the production of aërial tubers. I am, however, not aware whether this has been demonstrably proved. M. T. M.

March 8.

THE CEYLON PEARL FISHERIES AND THEIR ADMINISTRATION.[1]

A VERY remarkable feature of the Ceylon pearl fisheries has been their uncertainty and intermittent character. Thus only thirty-six fisheries took place during the nineteenth century, or, put in another way, for just half a century the fishery banks lay barren. These blank years sometimes followed one another in dreary succession, as may be seen from the fact that for seventeen years—from 1837 to 1854—and again for nine years—from 1864 to 1873—practically no fishing was done. For a decade before the investigation embodied in this report was begun the beds lay

[1] "Report to the Government of Ceylon on the Pearl Oyster Fisheries of the Gulf of Manaar." By W. A. Herdman, D.Sc., F.R.S., &c. Part I. Pp. xii+307. (London: Royal Society, 1903.)

tenantless. Occasional breaks of five years or less account for the remainder of these years of famine. But this apparently inexplicable state of affairs is by no means of modern date; for centuries these fat and lean seasons have been the despair of those interested in the collection of these gems.

All kinds of theories, or rather speculations, have been promulgated, but the mystery remained, until now, as impenetrable as ever. Undoubtedly, then, the immense importance and value of these fisheries called for some effort on the part of the Government, not only to attempt a solution, but also to find a remedy for these years of failure. To this end the Colonial Office, acting on the advice of Prof. E. Ray Lankester, invited Prof. Herdman to examine the records on this subject and to report to them. As a result of this report Prof. Herdman was induced by the Government to make a personal inspection of the pearl banks. Taking with him Mr. Hornell as his scientific assistant, he accordingly set out for Ceylon, and instituted a thorough examination of the whole question, the results of which are set out, in part, in the volume before us. Without doubt the task that lay before these investigators was no light one, and it is equally certain that it has been admirably fulfilled. As the pages of this volume show, the expedition has not only been abundantly fruitful in scientific results, but it has achieved the purpose for which it was dispatched.

A complete survey of the whole sea bottom of the pearl fisheries area has now been made, partly by sounding and dredging and partly by the aid of divers. In some cases even, Mr. Hornell himself descended in a European diving dress. By this survey a thorough knowledge has been gained, not only of the nature of the ground best suited for the growth of the pearl oyster, but also of the dangers by which this animal is beset.

Flourishing beds may be depleted by the ravages of boring sponges, boring molluscs, starfishes, internal parasites, and fishes, though the destruction wrought by these is generally slight compared with the wholesale destruction caused by shifting sands due to currents, or churned up by the south-west monsoon. By way of illustrating the vast scale of catastrophes of this kind, an instance—one of several—may be selected here. One bed examined in March, extending over an area of sixteen square miles, was covered with enormous quantities of young oysters "so closely packed that the bank must have held not less than about a hundred thousand million." Early in November of the same year this spot was revisited, when this vast host was found to have vanished, having been buried in the sand or swept down the deep declivity outside the bed.

The loss which results from overcrowding is, on some beds, almost as wholesale. If, however, Prof. Herdman's suggestions are carried out, this enormous waste will in future be prevented by the simple expedient of transplanting to sheltered spots affording suitable conditions for growth and infection. Nature has often to be assisted in the preparation of these spots by the process known as "culching," that is, scattering the floor of the bed with rock, loose coral, and so on, to afford the necessary anchorage for the byssus of the young oyster.

What havoc may be caused by starfishes can be gathered from the fact that a bank examined in March, 1902, lodged a crop of oysters estimated at $5\frac{3}{4}$ millions; by March, 1903, they had nearly gone!

Over-fishing is another source of danger, though in future, if Prof. Herdman's plan of transplanting is judiciously carried out, this need not be feared. In many places, it has been discovered, fishing may be carried on by dredging instead of by diving, though there are many places where the nature of the bottom will still compel the services of the native diver.

On the question of the formation of pearls this book contains much of great interest, and yet fuller details are promised in the next volume. Only in extremely rare cases did these investigators find that the nucleus of a pearl is formed by a grain of sand. Boring sponges and burrowing worms cause the formation of pearls or pearly excrescences on the inner surface of the shell by the irritation which they set up. Pearls of a peculiar kind are found in the muscular tissues, usually the levators of the foot. These also have no organic nuclei, but seem to start as minute calcareous concretions, and may be extraordinarily abundant.

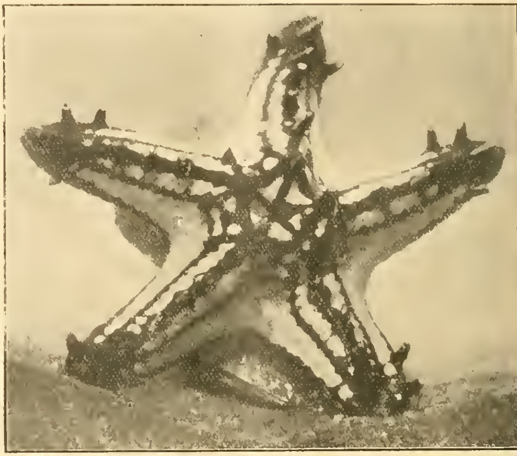


FIG. 1.—*Pentaceros lincki*, DeBl., lying on a large pearl oyster, half natural size. From a photograph by J. Hornell.

Thus, at the insertion of one of the levator muscles 23 small pearls were detected with the naked eye, whilst under the microscope 170 more tiny spherules were found. But the best "orient" or "cyst" pearls are those which occur in the mantle "or in the thick white lateral part over the stomach and liver, or even, secondarily, free in a cavity of the body." Caused by the secretion of concentric layers of nacre around the dead body of a parasite—generally that of a platyhelminthean larva—these pearls attain their greatest size in oysters of from three and a half to five years of age.

This parasite has an interesting history. Commencing life as a free-swimming embryo, it, in favourable circumstances, finds an entrance between the open valves of the oyster shell, or is drawn in by inhalent currents. The entry once gained, the next step is to bore into the tissues of the host, and here it undergoes the early stages of its growth. If the fates are propitious the host is eaten, and the developing worm escapes uninjured from the body of its first into that

of its second host a file-fish (Balistes). If the life-history is to be completed, the file-fish must in turn be swallowed by one of the large elasmobranchs, within the body of which the final adult stage is reached, and from thence escape the free-swimming embryos to renew the cycle. In these cases, however, where all runs smoothly—for the parasite—no pearls are formed. On the other hand, when the oyster escapes the file-fish, the larval parasite, unable to complete its development, dies, and becomes encapsuled by the pearly nacre deposited by the living tissues of the oyster upon the source of irritation.

Throughout his report Prof. Herdman bestows unstinted praise on the work of his assistant, Mr. Hornell, and there can be no doubt but that it is most thoroughly deserved, for much work of the highest importance was entrusted to him, and he in every case proved worthy of the trust. We are therefore glad that Prof. Herdman's wish has been fulfilled—

FIG. 2.—Valuation sample of pearl oysters from the Cheval Paar, being brought on board the *Kangasameeporawee* from the inspection boats. From a photograph by J. Hornell.

that Mr. Hornell should be asked to continue his observations as marine biologist at the Galle Laboratory —for he will now be able to render "signal service to the pearl, sponge, trepang and other marine fisheries of the Colony."

In concluding this notice we must not omit to mention that a series of separate reports has been prepared by various specialists on material collected during this investigation. Seven of these reports are included in the present volume, and others are to follow. The first of these deals with the geology of the sea-bottom, and describes the formation of the peculiar bottom essential to the presence and well-being of the pearl oyster. Mrs. Gepp, in an account of the algæ collected, describes the hitherto unknown fructification of a species of Halimeda.

The remaining reports are zoological, and describe the Gephyrea, Chitons, Holothurians, Cephalochorda, and Copepoda. Mr. Tatersall's report on Amphioxus will be read with great interest. No less than seven of the eleven species known occur around Ceylon. "The tables at the end of the report show how extremely variable the species of the group are, and the more extended our knowledge of this group becomes the less do the species appear to be separated." The report on the Copepoda, by Messrs. Thomson and Scott, is by far the largest of these supplementary reports, and embraces descriptions of no less than 283 species, of which 76 are new to science.

Further description of this most valuable book we cannot give. It must be read to be appreciated. The vast wealth of information contained in Prof. Herdman's report on the pearl oyster alone demanded far more space than we have been enabled to afford it. Enough, however, has probably been said to show that the commission was not only completely justified, but has resulted in a rich harvest of facts which appeal not merely to those interested in the pearl fisheries or to students of mollusca, but to the biologist the world over.

The volume is well bound, well printed, and profusely illustrated. W. P. P.

THE CAMPAIGN AGAINST MALARIA.[1]

THE unhealthiness of many tropical countries is largely due to the prevalence of malarial diseases. The discovery that a particular kind of mosquito is the definitive host of the malaria parasite paved the way for a method of prevention based upon the destruction of the malaria-bearing mosquitoes, which, so far as present knowledge goes, all belong to the genus Anopheles. At first the measures of prevention were individual rather than general, and included the destruction of mosquitoes in and about the house, and their exclusion by nets and wire gauze. But through the labours of Major Ronald Ross on the west coast of Africa, and of the Americans in Cuba and elsewhere, it has been shown that much may be done to free a whole town from mosquitoes, thereby diminishing the incidence of malaria.

The report under review details the measures initiated in India by the members of the Royal Society's Malaria Commission to test the efficacy of mosquito destruction in the prevention of malaria. The station selected was Mian-Mir, a cantonment near Lahore, the garrison of which consists of about 3900 officers and men, British and native, and of 600 native followers. Situated in a plain with an average rainfall of about 20 inches, little of the surface water can drain away, especially as the subsoil is exceedingly impervious, so that after one or two hours' rain the locality becomes flooded. In addition there are numerous brick-work surface drains, which become filled and form excellent breeding-places for the Anopheles until dried up by the sun. Owing to these conditions, Mian-Mir is one of the most unhealthy cantonments in India, the mean annual admission rate for ague among European troops averaging 663 per 1000. Six species of Anopheles were found to be present, of which *A. Rossii* was the most abundant, the numbers reaching a maximum in September and October.

The methods of prevention adopted were (1) the cleaning of irrigation water courses, smoothing their sides, and where possible lining with brick and cement; (2) drying out and cleaning branch water courses every ten days; (3) treatment of water courses with kerosene oil; (4) draining small collections of stagnant water;

[1] "The First Report of the Anti-malarial Operations at Mian-Mir, 1901–1903." By Capt. S. P. James, I.M.S. (*Scientific Memoirs* of the Government of India, No. 6. Calcutta, 1903.)

(5) constant attention to collections of water in gardens of houses and bungalows. In addition the segregation of Europeans was carried out to a limited degree, removing them from the vicinity of infected natives, treatment of all infected persons with quinine and the prophylactic use of quinine, the troops being paraded twice a week for this purpose. The results obtained were a distinct but not great diminution in the number of Anopheles present in the houses, and a diminution in the admission rate for ague to 269 per 1000, the lowest rate on record (1902 happened to be, however, an exceptionally healthy year). Captain James concludes that mosquito destruction, even though not obviously reducing the number of Anopheles, brings about a decrease in the amount of malaria, but is difficult to carry out and is expensive; apparently the campaign against the mosquitoes at Mian-Mir was not nearly so successful as that in Lagos. He attributes great value to the other measures, viz. the continued and systematic treatment with quinine of the native children, who are undoubtedly the chief source of infection, and the prophylactic use of quinine.

R. T. HEWLETT.

M. HENRY PERROTIN.

THE cause of astronomical science in France has been deprived of another of its ablest advocates by the lamented death of M. Perrotin, the director of the observatory at Nice. For more than twenty years M. Perrotin has watched over the growth and directed the energies of that institution. It was his good fortune, through the munificence of M. Bischoffsheim, to be able to erect and arrange a well equipped observatory to his own design, unhampered by legacies from former benefactors or directors. How the work grew under his hand astronomers have long since recognised and appreciated. As each instrument was completed it was immediately devoted to some special purpose. The meridian instrument was employed to determine the difference of longitude between Paris and the observatory, and to complete the chain Paris-Nice-Milan long before the observatory was in working order as a whole. The fifteen-inch equatorial was at work on double stars, planetary markings, comets, &c., before the large instrument of thirty inches aperture, under the mammoth "floating dome," could be devoted to the more rigorous scrutiny of faint and difficult objects.

It is scarcely necessary here to direct attention to the industry that marked the career of the first director of the Nice Observatory, or to the value of the researches produced by the staff under his guidance and encouragement. The work of M. Thollon on the solar spectrum may serve as a specimen in the department of spectroscopy. The discovery of many minor planets shows the care with which the photographic plates were taken and scrutinised. More particularly as the work of M. Perrotin, personally, should be mentioned his discussion of the inequalities in the orbit of Vesta, a research to which he devoted much time, interrupted as it must frequently have been by the care of the establishment under his charge. As an observer he was indefatigable, and devoted much time to the study of the faint markings on Venus, on Mars, and on Uranus. Aware that he was working at the extreme limit of visibility, and knowing the tendency for self-deception to creep in and impair the value of such delicate observations, he sought opportunities of making similar measures and records with different instruments, and under varied conditions, in order to remove, so far as possible, the evils of bias and partiality from the results of his researches. Excessive and painstaking care marked his efforts to secure rigorous accuracy.

Apart from his astronomical work, properly so called, in the department of physics, he added another determination to those that have been made on the velocity of light, which we recall here mainly to show the varied character of his researches and the energy which he displayed in whatever he undertook. His life was a busy one, and he did not spare himself. The great monument that he has left behind is the magnificent observatory at Mont Gros, and his greatest service to science is perhaps the activity which he inspired in those by whom he was surrounded. At the comparatively early age of fifty-eight he has succumbed, but he leaves behind him a memory that will be long treasured by all those whose fortune it has been to assist him in earning the reputation that the young observatory at Nice has already won.

NOTES.

THE Croonian lecture of the Royal Society will be delivered on March 24, the subject being "The Chemical Regulation of the Secretory Process," by Prof. E. H. Starling, F.R.S., and Dr. W. M. Bayliss, F.R.S. The Bakerian lecture will be delivered during May by Prof. E. Rutherford, F.R.S., of Montreal, on "The Succession of Changes in Radio-active Substances."

THE annual inspection of the National Physical Laboratory by the General Board will be held to-morrow, March 18.

PROF. OSTWALD will deliver the Faraday lecture of the Chemical Society on April 19 in the theatre of the Royal Institution.

PROF. AGASSIZ has been elected a foreign associate of the Paris Academy of Sciences in succession to Sir George Stokes; and Prof. E. Warming, Copenhagen, has been elected a correspondant of the academy.

SIR ARTHUR RÜCKER will deliver the academic address at the close of the present session at the University College of North Wales, Bangor.

DR. ROBERT LUTHER has been appointed professor of physical chemistry at the University of Leipzig.

THE deaths are announced of Dr. Wilhelm Schnell, professor of mechanics and synthetic geometry at the Technical School of Carlsruhe, and of Dr. von Pallich, assistant in physics and director of the meteorological station at the University of Graz.

THE Belgian Royal Academy has awarded its gold medal of 1000 francs to M. Marc de Selys-Longchamps for his memoir on the development of a Phoronis. The Théophile Gluge prize for physiology has been awarded to Dr. P. Nolf, of the University of Liège.

THE following have been elected associates of the Belgian Royal Academy (Classe des Sciences):—Profs. George Howard Darwin (England), Corrado Segre (Turin), Wilhelm Roux (Halle-sur-Saale), and M. Michel Lévy, of the French Geological Survey.

THE foundation of Schnyder von Wartensee offers, says *Science*, its prize of about 140*l*. for an essay on the climate of Switzerland during the last thirty-seven years. Essays, which may be in English, should be sent before September 30, 1906, to the library at Zurich.

A REUTER message from Rome reports that at 5.30 a.m. on March 10 a very violent earthquake shock, followed by four others, was felt at Magliano di Marsi. On the same

day two earthquake shocks were felt in the neighbourhood of Botzen, in the southern Tyrol, in consequence of which a large landslip occurred.

THE council of the Society of Arts will proceed to consider the award of the Albert medal for 1904 early in May next, and members of the society are invited to forward to the secretary, on or before April 2, the names of such men of high distinction as they may think worthy of this honour. The medal was struck to reward "distinguished merit in promoting arts, manufactures, and commerce."

A REUTER message from St. Petersburg states that a scientific expedition, organised by the Russian Ministry of Finance, will leave there for Abyssinia within the next few days. The expedition will be under the leadership of M. Kournakoff, mining engineer, and its object will be to explore the auriferous districts near the source of the White Nile.

THE following are among the lecture arrangements at the Royal Institution, after Easter:—Prof. L. C. Miall, three lectures on the transformations of animals; Mr. L. Fletcher, three lectures on meteorites; Mr. H. F. Newall, two lectures on the solar corona; Prof. Dewar, three lectures on dissociation; Mr. H. G. Wells, two lectures on literature and the State; and Sir W. Martin Conway, two lectures on Spitzbergen in the seventeenth century. The Friday evening meetings will be resumed on April 15, when Monsignor the Count vay de Vaya and Luskod will deliver a discourse on Korea and the Koreans. Succeeding discourses will probably be given by Dr. P. Chalmers Mitchell, Prof. E. Rutherford, H.S.H. the Prince of Monaco, Prof. S. Arrhenius, and other gentlemen.

WE hear from Stockholm of the death of the well-known zoologist, Prof. Fredrik Adam Smitt, which took place on February 19. Born on May 9, 1839, at Halmstad, he took his doctor's degree at Upsala in 1863, and became docent in zoology at that university. While in this position he joined Torell and Nordenskjöld in their expedition to Spitsbergen in 1861, went with Nordenskjöld's expedition to Beeren Island and Spitsbergen in 1868, and accompanied the frigate *Josefine* on her voyage to the Azores, England and North America in 1869. On the death of Prof. Sundevall in 1871, Smitt, though only thirty-two years old, was appointed to succeed him as professor and intendant at the natural history museum of the State. Smitt wrote several papers on marine Invertebrata, notably Bryozoa, but it is for his work on fish that he is best known, especially for his critical list of the Salmonidæ in the State museum. Of late years he paid much attention to the gobies. His scientific knowledge was freely bestowed in attempts to help the Swedish fisheries.

AT the annual meeting of the Association of Chambers of Commerce last week, it was resolved that the Government should be urged to grant early facilities for the passage of the Bill for compulsory adoption of metric weights and measures throughout the United Kingdom. A resolution was approved supporting the motion recently adopted by the Royal Society with regard to the position of science in higher education, and directing attention, in view of the competition with other countries, to the vital importance of a knowledge of science being recognised as an essential part of general education. After a discussion on Patent Law, it was agreed that "this association, whilst welcoming the instalment of reform secured by the Patent Law Amendment Act of 1902, is of opinion that further amendment is needed in order to secure the forfeiture of all foreign owned patents for inventions and designs workable in this country, which are not so worked within a reasonable limit of time."

IN the House of Lords on Tuesday Lord Barnard directed attention to the report of the Departmental Committee on British Forestry, and asked the President of the Board of Agriculture and Fisheries whether the Government proposed to take any, and, if so, what, steps to give effect to the recommendations of that committee on the subject of education, instruction, and training in forestry. In reply, the Earl of Onslow said that the Board of Agriculture proposed to act on the recommendations of the departmental committee. On Mr. Stafford Howard's initiative the first steps in that direction had already been taken. Without any assistance from the Treasury a school of forestry had already been established by the Commissioners of Woods and Forests in the Forest of Dean. Again, through the agency and assistance of the Office of Woods and Forests, the Scottish Office had entered into communication with certain Scottish landowners to secure suitable areas for planting. The Treasury had been approached by the Board of Agriculture, and had promised assistance in the foundation of at least two forestry schools in England. Where these schools would be established he could not yet say; but applications had been received from many colleges, and from the University of Cambridge. He had been considering whether the University of Cambridge should not have the first claim to the attachment of a school of forestry; but no decision could be arrived at until the Secretary of State for India had decided what was to be the future of Coopers Hill College. His desire was to establish the two schools in different localities—one for the training of young men who were likely to become landowners or land agents, and the other for woodmen. The former he should prefer to see attached to one of the great universities.

THE Survey Department of the Ministry of Public Works at Cairo has published its meteorological report for the year 1901. It includes hourly meteorological observations at Abbassia Observatory, with seismological and magnetic observations, monthly and yearly means at a number of second order and climatological stations, and ten years' means, 1891–1900, for Wadi-Halfa. Most of the stations send telegraphic reports, from which a daily weather report is prepared and circulated, including data from several Mediterranean stations.

THE Danish Meteorological Institute has issued, as in previous years, an abstract from its nautical-meteorological year-book showing the state of the ice in the Arctic seas during 1903. The conditions are shown on five charts, for the months April to August, and the particulars are discussed in Danish and English text. The conclusions drawn are (1) that about the normal amount of sea-ice from the Polar Sea entered the temperate seas; (2) that the Labrador current brought an unusual number of icebergs with it in 1903; (3) that there is no indication that the appearance of icebergs east of Newfoundland will be more frequent than usual in the year 1904.

THE activity of the Faraday Society has given a fresh impetus to our contemporary the *Electro-chemist and Metallurgist*, which is now the official organ of the society. The current number contains a report of the proceedings at the February meeting, at which M. Hollard's interesting paper on the electrolytic separation of metals was discussed, and a paper by Dr. Perkin on the electrolytic analysis of gold. There are also a large number of notes on

electrochemical matters, including a particularly full account of recent advances in battery work.

THE *U.S. Monthly Weather Review* announces that the Government of the Argentine Republic has determined to give a permanent character to the first-class meteorological and magnetic observatory on the island of Año Nuevo, situated in the vicinity of Staten Island, in latitude 54° 39′ south (Fig. 1). The observatory was established in order that the Republic might cooperate with the International Antarctic Expedition. It is equipped with a complete instrumental outfit, such as is appropriate to a station of the first order, and the results obtained during the International Antarctic Expedition, as also of the observations for the year 1903, will shortly be published. This observatory, as well as the one soon to be established at Bahia Blanca, will form a part of the proposed network of observatories on the Atlantic coast of the Argentine Republic. All correspondence should be addressed Observatory of Año Nuevo, Ministry of the Marine, Buenos Ayres.

FIG. 1.—Meteorological and Magnetic Observatory of the Argentine Republic on the Island of Año Nuevo.

WE have received a copy of the fifth edition of "Jelinek's Psychrometer-Tafeln" (Leipzig). The original name is presumably retained in deference to the former eminent chief of the Austrian Meteorological Service, who first compiled them. They were mostly recomputed by Dr. J. Hann, who also made several important additions to them. The new edition has been revised by Dr. J. M. Pernter, the present chief of the Austrian Service, who has added some elaborate tables for obtaining by inspection the vapour tension from the relative humidity values given by de Saussure's hair-hygrometer. He has also added to the foot of the psychrometric tables the corrections to the ordinary values due to conditions of calm and strong wind. We also find short tables for deducing the vapour tension at various altitudes up to 3000 metres. The tables are naturally much more comprehensive than those usually adopted in this country; they give the values for every tenth of a degree from −30° to 40° of the Centigrade thermometer. A list of the works relating to the dry and wet bulb hygrometer and to the hair-hygrometer is a useful addition to this valuable publication.

IN the University of Colorado *Studies*, Dr. Arnold Emch contributes a short note on the *p*-discriminant of ordinary differential equations, and discusses d'Arboux's proof that this discriminant in general represents the cusp-locus of the curves. In a second note the same writer discusses Newton's five types of plane cubics, and shows how to transform them by Steiner's method.

WE have had an opportunity of examining and testing an induction coil fitted with the Charpentier-Gaiffe patent platinum interrupter, sent to us by the Medical Supply Association, 228 Gray's Inn Road, and we find its performance fully equal to what is claimed for it. With two four-volt cells the full 10-inch spark was obtained with ease, and there was every indication that the interrupter was capable of working regularly for comparatively long periods without attention. In place of the iron hammer and spring of the old form, there is a light rigid strip of metal, faced with iron, resting by gravity on its lower edge in a shallow groove, and pulled downwards by an adjustable spiral spring. One of the platinums is carried by a flexible strip and remains in contact with a fixed platinum until separated by a blow from the hammer, the rapid motion of which produces a very sudden break. The intensity and frequency of the discharge can be readily varied by the adjustments of the platinums and hammer. The arrangement seems to make the most of a given battery power, and will therefore be specially appreciated by those to whom portability is an important consideration. Coils fitted with the new interrupter are supplied by the Medical Supply Association.

WE have received a paper on pulse and rhythm, contributed to the *Popular Science Monthly* by Mary Hallock-Greenewalt. In it the author endeavours to trace a connection between rhythm in music and the beats of the human pulse. In illustration a table is given of the metronome markings of the different movements of twelve of Beethoven's sonatas. Nineteen movements are set to rhythms of 72 or 76 beats per minute, rates exactly equal to those of a normal healthy pulse, and all the other markings range from just a little under 60 to 92, these limits representing the maximum range of pulse-action.

THE Johns Hopkins Hospital *Bulletin* for January (vol. xv. No. 154) contains Prof. Osler's address on the occasion of the opening of the new buildings of the medical faculty of the University of Toronto. It is entitled "The Master Word in Medicine," this being *work*. Miss Rowley, M.D., writes on some unusual forms of the malaria parasite.

THE United States Public Health and Marine Service has published a brief report by Dr. Howard on the geographical distribution of the yellow fever mosquito. After recording the localities in which the *Stegomyia fasciata* has been met with, he concludes that this species may be expected to occur in all regions the climate of which is not too dry between the parallels of latitude 38° north and 38° south, and in which the sum of the daily mean temperatures above 6° C. or 43° F. amounts to 10,000° C. or 18,000° F. for the year.

THE conquest of the Philippines by the United States has been followed by the establishment of a Government laboratory at Manila, which is already doing excellent work. The latest report is one on the subject of rinderpest in cattle, by Dr. James Jobling. No treatment seems to be of any benefit when once an animal has contracted the disease, but several methods of preventive inoculation may be successfully employed and are detailed, *e.g.* the injection of the bile of an animal dead of the disease, or of the blood of a "salted" animal, *i.e.* one that has recovered.

THE *Journal of Hygiene* (vol. iv. No. 1) contains several interesting papers. Dr. Bulloch and Mr. Macleod discuss

the chemical constitution of the tubercle bacillus. They find that it contains a large percentage of fatty substances, and that the "acid-fast" substance is an alcohol. Dr. Edington writes on a malarial form of South African horse sickness, and Dr. Bashford on immunity. Drs. Boycott and Haldane give a second instalment of their article on ankylostomiasis, and Dr. Durham discusses beri-beri in Malayia and in Christmas Island, which he visited as commissioner of the London School of Tropical Medicine.

In 1902 Major Ross, at the invitation of the Suez Canal Company, proceeded to Ismailia in order to advise upon a method to rid the town of mosquitoes, and as the result of his advice a series of measures was instituted to accomplish this. These consisted in filling in marsh land, a weekly flushing and cleansing of drainage channels, and, about the houses, petroleum treatment of drains and waste water that does not soak away. Prof. Boyce has recently made a tour of inspection, and reports that as a result of this anti-mosquito campaign, the mosquitoes in Ismailia are no more abundant than in Paris. Malaria also has much diminished, from 1555 cases in 1902 to only 209 cases in 1903. The expenditure to accomplish such results has not been great, 4400*l.* in the initial cleansing operations, and an annual outlay of 720*l.* (Liverpool School of Tropical Medicine, *Mem.* xii.).

In a paper read before the Royal Institute of British Architects, Prof. Clowes discusses the application of the biological method of sewage treatment to the sewage of Christ's Hospital at Horsham. The plant consists of closed septic tanks into which the sewage flows by gravitation, from whence the effluent is distributed over the surface of coke beds, the liquid remaining in the bed for two hours and then passing away as the purified effluent through drainage channels in the bottom of the beds. No hitch whatever has occurred in the working of the plant, and on one occasion only has smell been detected, the cause being stagnation during a lengthy vacation. Attention is specially directed to this occurrence and to its cause, as it probably explains why similar installations for the treatment of sewage from isolated buildings have become offensive. The solid matter is absolutely disposed of in the septic tank; the number of bacteria in the effluent is 32 per cent. less than in the crude sewage, and the effluent will support fish life.

An interesting and useful account of the present position and prospects of the Panama Canal is to be found in an illustrated article in the February number of the *National Geographic Magazine*, by the Hon. Wm. H. Burr, of the Isthmian Canal Commission, entitled "The Republic of Panama."

The December (1903) number of *La Géographie* contains two papers of geological interest. M. Émile Chaix-Du Bois writes on "Le pont des Orelles (Bellegarde, Ain)," giving a careful study, with a number of excellent illustrations, of a remarkable example of the effects of erosive action of running water. MM. Jean Brunhes and Louis Gobet give an account of the "glacier excursion" of the ninth International Geological Congress, which includes a valuable synthetic summary of the observations and theories of Prof. Penck.

Dr. R. Reinhard contributes an interesting paper to the *Deutsche Geographische Blätter* on the geographical conditions affecting the positions and development of the large German sea-ports. The port of Bremen is specially dealt with, but the discussion includes Hamburg, Kiel, Lübeck, Stettin, Danzig, and Königsberg. The study of the effects of the introduction of modern methods of transport by land and sea, and of the increased power of modern engineering to overcome local disadvantages, is of considerable geographical value.

An excellent summary of what is known about the occurrence of gold in Great Britain and Ireland has been written by Mr. J. Malcolm Maclaren (*Trans.* Inst. Mining Engineers, vol. xxv.). The earliest records of the discovery of gold are mentioned, and particulars are given of its occurrence in Cornwall, Devon, Cumberland and elsewhere in England; in Carmarthenshire and in the important district of Merionethshire in Wales; in the Leadhills district and at Kildonan in Scotland; and in several localities in Ireland. The paper is illustrated with sketch maps and numerous pictorial photographic views, and is accompanied by a bibliography of the subject.

Dr. G. J. Hinde contributes to the *Journal* of the Royal Microscopical Society (February) an important article on the structure and affinities of the genus Porosphæra. The genus was established for certain small rounded fossils commonly met with in the Chalk, and referred by old authors to Foraminifera, sponges, and Polyzoa. Dr. Hinde shows that the organism is clearly a calcisponge. Several species are figured and described, and their zonal range and distribution in the English Chalk are recorded.

A stratigraphical interest attaches to a short paper by Messrs. Steinmann, Hoek, and von Bistram, who have been travelling together in south-eastern Bolivia (*Centralblatt fur Mineralogie*, &c.). A series of red sandstones, gypsiferous clays, limestones, and dolomites, easily taken for Permian or Triassic beds, is shown to contain a marine band near Miraflores, possibly of Jurassic, but more probably of Cretaceous age. This supports the view that the corresponding petroleum beds in Argentina are Cretaceous. Extended traces of glacial phenomena, including enormous moraines of southern Alpine type, are noted in the mountains east of Potosi, down to heights of 4000 metres.

A paper by Dr. G. Steinmann on *Tetraploporella Remesi* (*Beitrage zur Palaontologie und Geologie Osterreich-Ungarns und des Orients*, Bd. xv., 1903, p. 45) will be of interest to botanists as well as to palæontologists. This new genus, from the Tithonian, is ascribed to the Dasycladaceæ, with Dactylopora, Diplopora, &c., and resembles a highly calcareous Bornetella. Incidentally, the much discussed genera Cyclocrinus and Receptaculites are considered, and the author doubts if they can be referred to the calcareous algæ.

The secretary has sent us a copy of the report of the Anti-Bearing-Rein Association for the second half of 1903, from which it appears that no efforts are spared by that body to continue the crusade against inflicting unnecessary discomfort and pain on draught horses of all classes.

The report for the year 1903 shows that the Yorkshire Naturalists' Union is still in debt (something more than 100*l.*) to its treasurer, a part of the deficit being due to that useful publication, the *Naturalist*, upon which there was a loss of 22*l.* A county of the size and wealth of Yorkshire ought surely to be able to keep the balance of the association on the right side.

The March number of the *Field Naturalists' Quarterly* contains a long article, by Mr. R. H. Wallace, on the now well-worn subject of the place of "nature-study" in education. Certain of the suggested schemes of work in connec-

tion with spring flowers savour, to our thinking, somewhat too much of the methods of the faddist and of the crank. The editor, Dr. G. Leighton, continues his "Reptile Studies," dealing in this instance with the distribution of the British species. Perhaps, however, the most generally interesting article in the issue is one by Mr. W. H. Legge on Ringmer, a favourite Sussex resort of Gilbert White.

We have received four parts of the *Proceedings* of the U.S. National Museum (Nos. 1361, 1362, 1363, and 1367), all devoted to invertebrates. In the first, Mr. C. F. Baker points out the remarkable fact that while in the United States fleas nearly allied to the human *Pulex irritans* infest such animals as the dog, cat and rabbit, in Mexico and South America species even more nearly related to the former are found on rats, mice, and other small rodents. Hence there is a great probability, in the latter instance, of the communication of serious diseases to human beings by these insects. In No. 1367 Mr. J. E. Benedict points out the probability that the enormously elongated antennulæ of crustaceans of the genera Albunea and Lepidopa, which are furnished with hair-like fringes, are for the purpose of preventing the sand in the water from reaching the mouth.

The report of the Liverpool Marine Biology Committee for 1903 contains an account of the first year's working of the new biological station at Port Erin, in the Isle of Man. From a financial point of view it is satisfactory to learn that the aquarium is very popular with tourists, and that a substantial sum was received from their gate-money. During the year very successful progress has been made with the experiment of hatching and rearing lobsters, and some remarkable hauls of plankton and the discovery of several rare and interesting animals have been made. Special interest attaches to the hatching of a number of cuttlefish eggs, the commencement of the process taking place after a sojourn of eighty days in the tank. The committee has to deplore the loss of its energetic and talented secretary, Mr. I. C. Thompson, of whom a memoir appears in the report, at the comparatively early age of sixty. A considerable portion of the report is devoted to a pronouncement of the general aims of biological study and the urgent need of further efforts in this direction in Britain. The writer is of opinion that as the older naturalists pass away their place is not taken by younger men, and he deplores that such a state of affairs should exist, even locally.

According to Mr. Southwell's report on sealing and whaling for the past year (the twenty-third of the series), published in the February number of the *Zoologist*, the trade in seal skins and seal oil has become specially lucrative on account of the marked rise in prices, and the demand in America. In seal-oil the price has advanced from 18*l.* per tun (some years ago) to 28*l.*, while skins which were then worth half a crown now realise 3*s.* 6*d.* each. Sealing will, therefore, undoubtedly be on the increase, but, as Mr. Southwell remarks, this means a black lookout for the seals themselves, and it may be hoped that measures will be taken in time to prevent anything approaching extermination. The year's catch of right whales was small, but several were seen which, owing to the bad weather and heavy ice, could not be pursued. Owing to scarcity of whales and other causes, the Norwegian fin-whale catch has been comparatively only small, the two Ronas Voe companies having captured only 126 head. If it be true that in 1902 the Norwegian fleets accounted for no less than 2500, the scarcity of these whales is no matter for wonder, and ere long they must be well-nigh exterminated. Mr. Southwell alludes to the appearance last summer of a large school of sperm-whales in the seas between Iceland and Norway, of which an account has already appeared in the *Field*.

We have received a copy of the first part of "Documents Scientifiques de la Mission Saharienne: Mission Foureau-Lamy d'Alger au Congo par Le Tchad," by M. F. Foureau, the leader of the expedition. The work is being published by Messrs. Masson and Co., of Paris, for the French Geographical Society, and is to consist of several parts, forming together a volume of from 800 to 1000 pages. The present fasciculus includes an introduction and two sections, dealing respectively with astronomical and meteorological observations. In his prefatory remarks M. Foureau details the steps which preceded the expedition of 1898, with which the present work is concerned, and gives interesting particulars of nine journeys of exploration in the Sahara he had undertaken before that date. Our notice of the scientific work accomplished must be deferred until all the parts of M. Foureau's volume have been received.

Plate xi. of the January number of the *Emu*, herewith reproduced on a smaller scale, illustrates the "play-ground" of one of the species of bower-bird, *Scenopaeus dentirostris* (Fig. 1). The original photograph was taken by Mr. E. M. Cornwall, who states that the area was situated

Fig. 1.—"Play-ground" of the Tooth-billed Bower-bird. (From the *Emu*.)

among a tangle of "lawyer-palms, in which a gap had to be made for the camera. The play-ground, which was of considerable size, had been cleared of dead leaves, and was kept scrupulously clean; but at the date of the visit a number of large fresh leaves were strewn over it, apparently as ornaments. "In the morning," according to Mr. Cornwall, "all the birds were noticed low down amongst the scrub, quite close to the play-ground, whilst towards sundown they were invariably perched high up amongst the topmost branches of the trees, but still in the immediate neighbourhood."

A somewhat remarkable process of oxidation is described by Dr. Geisow in the *Berichte*. It was noticed some years ago by Blank and Finkenbeiner that when formaldehyde was oxidised in alkaline solution by means of hydrogen peroxide an inflammable gas was liberated which appeared to be hydrogen. An investigation of the course of the oxidation in neutral and acid solution has shown that under these conditions no formic acid is produced, and that the sole products of the oxidation are carbon dioxide and hydrogen, which are produced quantitatively according to the equation $CH_2O_2 + H_2O_2 = CO_2 + H_2O + H_2$.

SOME interest attaches to the preparation of optically active hydrocarbons of the benzene series as described by Messrs. Klages and Sautter in the *Berichte*. A dextrorotatory hexenylbenzene, $C_6H_5.CH:CH.CH(CH_3).C_2H_5$, having $[\alpha]_D+50°\cdot3$, was prepared by condensing amyl iodide with benzaldehyde by Grignard's magnesium method, and this was reduced to a hexylbenzene,

$$C_6H_5.CH_2.CH_2.CH(CH_3).C_2H_5,$$

which gave $[\alpha]_D+17°\cdot2$. The latter compound behaves in a normal manner as a homologue of benzene, and it should, therefore, be possible to prepare from it optically active derivatives of all the most important types.

THE additions to the Zoological Society's Gardens during the past week include a Snow Leopard (*Felis uncia*) from Tibet, presented by Major Cox; a Lesser White-nosed Monkey (*Cercopithecus petaurista*) from West Africa, presented by Mrs. Gower; a Mozambique Monkey (*Cercopithecus pygerythrus*) from East Africa, a Yellow Baboon (*Papio cynocephala*) from Africa, a Green Monkey (*Cercopithecus callitrichus*) from West Africa, a Ring-tailed Lemur (*Lemur catta*) from Madagascar, a Common Rat Kangaroo (*Potorous tridactylus*) from Australia, a Lesser Vasa Parrot (*Coracopsis nigra*) from Madagascar, a Blossom-headed Parrakeet (*Palaeornis cyanocephala*), two Larger Tree Ducks (*Dendrocygna major*) from India, deposited; two Himalayan Pheasants (*Lophophorus impeyanus*) from the Himalayas, purchased.

OUR ASTRONOMICAL COLUMN.

A SIX YEAR PERIOD FOR THE POLAR MOTION.—Writing to the *Astronomische Nachrichten* (No. 3932), Mr. H. Kimura, of the International Latitude Station, Mizsusawa, states that he has found that the x and y curves of the polar motion return to the same phase (not amplitude) every six years. This is shown very clearly on the curves accompanying the note.

The latest maximum deviations of the instantaneous pole occurred in 1891 and 1897, whilst the minima deviations were in 1894 and 1900.

The actual x and y curves obtained from the observations may be fairly represented by calculated curves derived from the combinations of two periods of 438 days and 365 days respectively.

During his researches on this subject Mr. Kimura has discovered that there are important systematic variations of purely local character which are as yet unaccounted for.

DOUBLE STAR OBSERVATIONS.—During his absence on leave from the Hong Kong Observatory, Prof. Doberck has observed 280 double stars, mostly taken from the Struve catalogues. The name, coordinates, position angle, and distance of each pair are given in a list published in Nos. 3830 and 3831 of the *Astronomische Nachrichten* as a continuation of the previous list which appeared in Nos. 3860 and 3861. In cases where there are more than two components in any one system, the angles and distances between each pair are given. The observations were made at Copenhagen.

CORRECTIONS TO THE BERLINER JAHRBUCH FUNDAMENTAL CATALOGUE.—In Nos. 3927, 3928 and 3929 of the *Astronomische Nachrichten*, Dr. A. Auwers publishes the results of his discussion of the observations, made between 1750 and 1900, of the 622 stars of the Astronomische Gesellschaft Fundamental Catalogues, which were published in the *Berliner Jahrbuch* in 1883. After a lengthy discussion of the reduction of the observations, Dr. Auwers gives a table showing the total corrections to the places for 1875, and then discusses several multiple systems, for each of which he gives the elements he has computed. In a second table he compares the corrections and the hundred-year proper motions given in his tables with those given by Boss, for each five degrees of declination and right ascension.

COOPERATION IN SOLAR OBSERVATIONS.—In No. 1 (1904) of the *Memorie della Societa degli Spettroscopisti Italiani* Prof. Ricco discusses the modern methods of studying solar phenomena, and points out the vital importance of obtaining as full a record as possible of all the changes which take place in the sun. He also describes the results obtained by Prof. Hale with the spectroheliograph, and directs attention to the important connections which have recently been shown to exist between solar and meteorological changes.

A STUDY OF THE RADIO-ACTIVITY OF CERTAIN MINERALS AND MINERAL WATERS.[1]

PART I.

A CONSIDERABLE number of minerals are known in varying degrees to be radio-active. Lists have been given by M. and Madame Curie ("Thèse présentée à la Faculté des Sciences," Paris, p. 19) and by Sir W. Crookes (Roy. Soc. *Proc.*, vol. lxvi. p. 411). Except in the case of pitchblende, little has been done to determine the nature of the radio-active constituents, or to decide whether any hitherto unknown radio-active body is present.

To obtain complete information on these subjects, the only method available would be completely to analyse the mineral, and examine every precipitate and filtrate for radio-activity. This process is, of course, very tedious, and the results have to be interpreted with care, since traces of radio-active elements may often be carried down in the groups to which they do not properly belong, and thus cause confusion. A much easier method is to heat the crude mineral, and to examine the rate of decay of the emanation which it gives off. Each emanation has a characteristic time constant of decay, and by determining this we can identify it.

The method is, of course, useless for testing the presence or absence of radio-active elements such as uranium[2] which do not give off a characteristic emanation. But the great facility with which it may be applied to a small quantity of material, and the definiteness of the results, are great merits.

In any case when a material suspected to contain radium is obtainable in abundance, it is better to test for the presence of emanation than to look for activity in the solid. For but little of the solid material can be advantageously used in the test. Thick layers give no larger effect than thin ones, since the upper layers absorb the radiation from the lower. But the emanation can be extracted from any desired bulk of material, and the effect proportionately increased. If carbonic acid or any other gas is evolved at the same time in inconvenient quantities, it can be absorbed with a suitable reagent, and the emanation contained in it thereby concentrated.

The present paper gives the results of an examination of certain radio-active materials by this method.

No new emanation has been recognised. The results have in all cases been attributable to thorium and radium.

If any emanation decidedly more permanent than that of radium existed in the evolved gas, the method could not fail to detect it. For in every case the activity of the gas was watched until it became comparable with the very small activity due to the walls of the vessel. If a more durable emanation had been present even in small quantities, the proportion of it present would have increased relatively to the radium emanation, and its presence would have become apparent towards the end by a diminished rate of decay.

Small quantities of an emanation less durable than that of radium might have escaped detection. For they would have been masked by the much greater quantity of the latter.

By measuring the rate of leak due to the accumulated

[1] By Hon. R. J. Strutt, Fellow of Trinity College, Cambridge. Read before the Royal Society, March 10.

[2] I have found a distinct, though feeble, emanation from recrystallised uranium nitrate, having a rate of decay equal to that of the radium emanation. Whether this is really due to uranium, or to traces of radium, which the uranium still contains, must be left for the present an open question.

emanation from a weighed amount, the proportion of radium present may be estimated. A comparison with the leak due to the emanation of a known weight of radium must of course be made. For this purpose it would be best to weigh out, say, a milligramme of radium bromide, dissolve it in a litre of water, and evaporate a small measured quantity of the solution in a suitable tube. In this way the effect due to a standard quantity could be determined.

The method of experimenting was as follows:—

The powdered mineral was placed in a hard glass combustion tube, drawn out and sealed at one end, connected to a mercury gas-holder at the other. The mineral was heated to redness, and the gaseous products collected in the gas-holder. When the evolution of gas had ceased, the point was broken off, and air drawn into the gas-holder up to a standard volume.

For measuring the electrical effects an electroscope was used. This was exhausted, and the gas extracted from the mineral, together with the air, which had been used to make up its volume to a sufficient amount, was admitted. After a few hours, enough for the deposited activity to attain its full value, the rate of leak was read. The day and hour were noted, and the gas was pumped out into a test-tube and stored over mercury. After a sufficient time had elapsed it was again introduced into the apparatus by means of a syphon gas pipette[1] and the rate of leak again measured. In the meantime the apparatus had been available for making measurements with other gases.

In some cases the emanation was initially so strong that it could not be conveniently investigated. In such cases a portion of the gas was diluted with air for measuring the rate of decay at first. The concentrated material was kept until, by lapse of time, it had become weak enough to be conveniently used. Its activity was followed until it had become too small for measurement.

With this preface the results for the various minerals tried may be given in the form of a table. The rates of leak are given in scale divisions per hour. When air alone filled the apparatus, the rate of leak was 2·25 sc. div. per hour. This was in each case subtracted.

Mineral	Locality	Quantity taken in grammes	Rate of leak due to emanation (sc. div. per hour)	Rate of leak per 100 grammes	Time in days taken by the emanation to fall to half its initial value
Samarskite .	N. Carolina, U.S.A. .	20	20,600	103,000	3·48
Fergusonite .	Norway?	7	4,280	61,000	3·80
Pitchblende .	Cornwall	40	11,900	29,800	3·50
Malacone . .	Hitteroe, Norway .	20	1,440	7.200	3·81
Monazite . .	Norway	51	2.060	4,000	3·50
,, . .	N. Carolina	82	37	45	3·81
,, . .	Brazil	54	11	24	3·80
Zircon . . .	N. Carolina	60	24·6	41	4·05

All the minerals give radium emanation, though in very varying quantity.

These tests were not started quickly enough to give information as to the presence of a very quickly decaying emanation. This was tested for independently.

The mineral malacone is of peculiar interest, because it has been found to contain argon as well as helium (Ramsay and Travers, Roy. Soc. *Proc.*, vol. lxiv. p. 131). Helium is formed by the degeneration of radium, and it is reasonable to assume that the other kindred gases have had a similar origin. It was hoped, therefore, that malacone might contain some new radio-active element. It is still possible that it does so, but, if so, this substance gives no emanation distinct from that of radium.

The meteorite of Augusta, co. Virginia, has also been found to contain argon and helium. But no emanation at all could be obtained from [illegible] grammes of it.

The minerals were all tested for thorium emanation by drawing air over them in the cold; the only one in the above list that gives it is the Norwegian monazite, and even this does not yield it very abundantly. A crystal of thorite, however, kindly lent me by Prof. Lewis, was found to give torrents of thorium emanation. Air drawn over it in the cold possesses strong discharging power. It was not permissible to heat the specimen, which might have injured it, so that the presence or absence of radium emanation in thorite could not be investigated.

There can be no doubt that the other specimens of monazite contained thorium, for they were given me by the late Mr. W. Shapleigh, who was connected with the thorium industry, and used these varieties of monazite for preparing thoria. They were, moreover, markedly radio-active, while the amount of radium emanation obtained from them was so small that their activity could not be mainly due to radium. They probably contain the thorium in what Rutherford and Soddy call the de-emanated condition, that is, the thorium emanation, though formed, is not able to escape.

It is a remarkable fact that these varieties of monazite, though they contain practically no radium, yield helium in fair quantity. There are several explanations possible. The radium originally present may have almost completely decayed into helium, and any other products which it may yield; or it may be that thorium, as well as radium, yields helium by its decomposition; or, lastly, the helium may not, in this instance, have been generated by radio-active changes at all.

It is interesting to know whether the minerals retain all the radium emanation which they generate when heat is not used to expel it. Two cases were examined. One hundred and fourteen grammes of powdered samarskite were kept for three weeks in a sealed glass tube. The air was pumped out and tested. It was found to contain about 1/150th part of the emanation, which could have been extracted by heat.

A similar experiment with malacone showed that about one-fiftieth of its emanation was able to escape in the cold.

It appears, therefore, that these minerals retain nearly all their emanation. The same is probably true of the helium produced by the emanation. Samarskite which had been heated to redness was found to retain its emanation in the cold about as well as before.

Part II.

I happened to possess a small sample of a red deposit, coloured by iron, which is left by the water of the King's Spring, at Bath. It occurred to me that it might be worth while to test this for radio-activity. The result was to show that the deposit was markedly active. On leaving it in the testing vessel (which was closed airtight) for a few days, the activity was found to increase to several times its initial value. This shows that the deposit gives off an emanation freely, even without heat.

Experiments were then made to test the rate of decay of this emanation. It proved to be identical with the rate of decay of the emanation of radium.[1] The activity is wholly due to that element.

This deposit was collected inside the King's Well itself, where the hot water issues from the ground. Other deposits are left in the tanks and pipes. They are less active than that collected near the source.

Deposits from another of the hot springs at Bath, that known as the Old Royal Spring, have also been tested. These were found to be active also. In this case there was no opportunity of collecting the deposit at the well head itself, but it was found that the deposit left in the channel near the source was more active than that in the tanks further from it.

It was interesting to determine whether the water itself contained any radium in solution. There could be little doubt that there must be traces left in solution, after the deposit had settled out. But, since the Bath water contains

[1] The methods of manipulation used in storing and transferring the gases without loss were those described in Dr. Travers's book, "The Study of Gases."

[1] In the first experiment made, I obtained a small residual leak when the radium emanation had decayed. This was attributed to a new emanation, of greater durability. But I have failed to repeat the experiment, and am forced to conclude that the leak was due to a failure of the quartz insulation, owing to the presence of moisture. It is very difficult to understand how this can have happened, for the gas was passed through drying tubes. When the rate of leak was tested with air in the apparatus, it had always a perfectly definite and constant small value.

abundance of sulphates, and since radium sulphate is one of the most insoluble salts known, there could not be more than the merest traces present. The sulphate of barium is very much less soluble than that of strontium, and presumably the sulphate of radium is much less soluble still. Barium sulphate requires half a million times its weight of water to dissolve it; radium sulphate perhaps several hundred million times its own weight.

About 10 litres of the Bath water were evaporated to dryness. The resulting saline residue was sealed up in a hard glass tube, and left for about a fortnight to generate a stock of emanation. On heating, a distinct emanation was obtained, giving several times the rate of leak that air did. A deposit, similar to that from the Bath water, but black in colour, can be collected from the source of the hot springs of Buxton. It has been analysed by Dr. J. C. Thresh (*Proc.* Chem. Soc., January 17, 1882), and I am indebted to his kindness for a specimen of it. This deposit was found to contain radium also, the proportion present being not very different from what was found in the case of some of the Bath deposits.

The following table gives the quantitative data for these emanations from these deposits. The rates of leak are on the same scale as those in the preceding table.

Material	Quantity taken in grammes	Rate of leak due to emanation (sc. div. per hour)	Rate of leak due to emanation from 100 grammes	Time in days taken by the emanation to fall to half its initial value
King's Spring, Bath—				
Deposit from inside of well	10	250	2,500	3·60
,, ,, tank	12	78·2	650	—
Saline residue from water	18	12·4	69	—
Old Royal Spring, Bath—				
Deposit from channel near well	10	63·5	635	—
,, ,, bottom of tank	15	60	400	—
Hard deposit from sides of tank	25	43	173	3·58
Buxton deposit	26	356	1,370	3·81

It will be seen that the richest of the deposits is some thirty-six times more active than the salt obtained by evaporating the water.

Although the agreement in the rate of decay of the emanation seemed sufficient to prove that the activity was really due to radium, yet it was thought desirable to show that the chemical properties of the active constituent were in agreement with this conclusion. Two hundred grammes of the richest deposit were treated with dilute sulphuric acid. The activity was all in the insoluble residue, which was dirty white in colour, and amounted to about half the entire quantity of deposit. The residue was boiled with strong sodium carbonate solution. This was washed away, and the mass extracted with hydrochloric acid. The hydrochloric acid solution gave a slight precipitate with sulphuric acid. This precipitate was collected, and found to be strongly active, so that there is every reason to conclude that the activity of the deposit is due to the presence of radium.

The presence of radium in the Bath water and deposits is of special interest because of the occurrence of helium in the gas which rises with the spring (Rayleigh, Roy. Soc. *Proc.*, vol. lx. p. 56). There can be little doubt that the helium owes its origin to the same store of radium that supplies the water.

It is interesting to estimate the quantity of radium annually delivered by the spring. Part of this is in the deposit, part in the water. But the annual yield of deposit does not exceed a few hundredweight at the most; and although it is much richer in radium than the dissolved salt, the quantity of the latter is so enormously greater that the deposit may be neglected. According to the estimate of Sir A. C. Ramsay, the late director of the Geological Survey, the salt annually delivered by the spring would be equivalent in volume to a column 9 feet in diameter and 140 feet high. Taking the density to be twice that of water, this would weigh about 500,000 kilogrammes.

Now the saline residue gives about 1/1500th part of the quantity of emanation that samarskite gives. Let us assume that the latter contains one-millionth part of radium, which is, I think, an outside estimate. At that rate, the annual delivery of radium by the spring amounts to about one-third gramme. The volume of gas which the spring delivered is about 100 cubic feet per day (Williamson, British Association Reports, 1865, p. 380). About 1/1000th part of this is helium, so that about 3 litres of helium are given off daily, or about 1000 litres per annum. The proportion of helium to radium thus indicated is of the same order as in the radio-active minerals, though somewhat larger. This is in accordance with the view that the spring draws its supplies from the disintegration of such minerals.

In obtaining the various materials from the Bath springs, I have had the great advantage of Mr. Sydenham's help. His knowledge of everything connected with the springs has been of great assistance.

In addition to the Bath and Buxton waters I have examined several others.

A sample of the Cheltenham saline water, and also a deposit left in the pipes, was kindly sent me by Mr. G. Ballinger. But no emanation could be obtained, either from the dissolved salts or from the deposit.

The boiler crust from a domestic hot water pipe, Terling, Essex, was examined, but the result was again negative.

THE MINING OF NON-METALLIC MINERALS.[1]

THE four Cantor lectures delivered before the Society of Arts last year by Mr. Brough, and now published as a pamphlet, form a fitting sequel to the course which he gave in 1900 upon metalliferous deposits. The title "non-metallic minerals" must be taken in the popular and not in the strictly scientific sense, and is intended to include all the useful minerals which are not employed as sources of the common metals. Mr. Brough classifies these minerals into four groups, viz. coal and bitumens, salts, stone and precious stones.

FIG. 1.—Magnesite Quarry, Salem, India.

[1] By Mr. Bennett H. Brough. Pp. 48 and 15 figures. (*Journal* of the Society of Arts, December 25, 1903, January 1, 8, 15, 1904.)

The progress of the world during the last half-century becomes strikingly evident if one reflects how very different the lectures would have been if the course had been delivered fifty years ago. Apart from the enormous expansion of the coal trade, various great industries have arisen due to the working of minerals which were unknown, or little used, at the time of the Great Exhibition of 1851. It is only necessary to refer to the petroleum of Russia and the United States, the potash salts of Germany, the borates of California, the nitrate of soda of Chili, and the phosphates of various countries.

The provision of a cheap and convenient illuminant like petroleum may seem a small matter to the present generation of town-dwellers accustomed to the electric light or to Welsbach burners; but those whose memories go back to the days of the guttering "dip" and its snuffers can realise what petroleum has done for the winter evenings of our villages and those of distant lands; and, of course, petroleum has many other uses.

Mr. Brough has not confined his lectures to a mere compilation of published information. His own extensive travels enable him to give descriptions of various workings which he himself has visited, and, in addition, he has been able to obtain accounts from competent observers on the spot, and to illustrate them by reproductions of photographs. We learn from the accompanying figure, reproduced from Mr. Brough's paper, that magnesite is quarried in a primitive fashion at Salem, which lies half-way between Madras and Beypore. The stone is carried away on the heads of women to the mills. The Indian magnesite is exceedingly pure, and therefore admirably adapted for the manufacture of fire-bricks.

The last lecture contains not only many interesting details concerning gem-mining, but also affords useful information concerning the sources of thoria, now in demand for the manufacture of incandescent mantles.

The addition of a complete index considerably enhances the value of the pamphlet.

OBSERVATIONS OF THE PLANET JUPITER.

JUPITER has now approached so near to the sun as to be invisible for all practical purposes, and observers must wait until the mornings of next June before telescopic work can be renewed with prospective success.

The study of his surface markings during the past nine months has evolved some interesting facts which will prove useful for comparison with those obtained in preceding years. It is from the continued study of Jovian features during many successive oppositions that we may hope to learn something more definite as to the nature of the curious phenomena operating on his surface.

Essentially different in its aspect and character from the more durable lineaments observed on Mars, the scenery of Jupiter consists of variable bands of light and dark material circulating round the great planet at dissimilar periods. Apparently we see nothing of Jupiter's real surface formations; the belts and zones exhibited in our telescopes represent vapours spun into parallels of latitude by the rapid rotatory motion of the globe beneath.

The study of Jupiter is chiefly directed towards determining the rate of motion of the various currents and to noting the more active regions and forms and tints of the principal features. During the last half of 1903 the red spot appeared to be a little plainer than during the few previous oppositions, and it exhibited a decided retardation of velocity, its rotation period being 9h. 55m. 41·6s., as in the last few years of the nineteenth century.

The equatorial spots, of which there were about twenty-eight fairly conspicuous examples presented, gave a rate of 9h. 50m. 27·9s., agreeing very closely with the mean value for the previous six years.

The south temperate spots travel from year to year at a very uniform rate of motion, and this was further exemplified in 1903, the mean period of nine spots being 9h. 55m. 18·5s.

The north temperate spots moved more slowly than any others on the disc, the rotation of nine objects in this region averaging 9h. 55m. 54·3s.

A number of large dusky spots were seen in high northern latitudes in 1903. Some of these in about lat. $+55°$ were carefully watched, and their periods were found nearly conformable with the period of the red spot.

A few irregular markings were observed in the region of the north and south poles, but owing to the bad definition usually prevailing, a sufficient number of observations of them could not be secured. During the last five months of 1903 the weather conditions were usually bad, and very delicate planetary features were obliterated on the very unsteady, indistinct images. Between 1903 May 26 and 1904 February 2 I examined Jupiter on 109 nights, the definition being noted as "bad" or "very bad" on 58 nights, while it was recorded as "good" or "very good" on 30 nights only. In all, 1388 transit times of various spots were secured, and the rotation periods of seventy different objects determined.

W. F. DENNING.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—The degree of Doctor of Science, *honoris causa*, is to be conferred on Dr. Wilhelm Ostwald, professor of chemistry in the University of Leipzig.

Mr. H. Y. Oldham, King's, has been appointed to the readership in geography for a period of five years, under the new conditions.

Mr. F. Horton, B.A., St. John's, has been elected to the Allen studentship of 250*l*. for research in experimental physics.

THE Senate of Aberdeen University has agreed to confer the degree of Doctor of Laws upon Sir George Watt, the officer in charge of the Industrial Museum at Calcutta, and Prof. Wyndham R. Dunstan, F.R.S., director of the Imperial Institute.

THE Senate of Glasgow University has resolved to confer the honorary degree of Doctor of Laws on Mr. G. F. Deacon, civil engineer, London; Dr. W. Stirling, Brackenbury professor of physiology and histology at Owens College, University of Manchester; and Sir William Taylor, Director-General of the Army Medical Service.

AN examination in biological chemistry will be held at the laboratories of the Institute of Chemistry in October next. The examination will extend over four days, and may be theoretical, practical, written and oral. The syllabus will include biological chemistry, with special reference to the chemistry and bacteriology of foods, water, sewage and effluents, and to the practical applications of biological chemistry to industries.

THE Board of Education has approved the draft scheme for the Education Committee for London, submitted by the County Council. The education authority for the metropolis will thus not include members co-opted on account of special knowledge or experience of educational problems. The letter from the Board of Education contains the remark that "In expressing their approval, the Board must not be understood to accede without regret to the desire of your Council to limit the Committee so closely to members of their own body."

A REUTER message from Calcutta states that the Indian Government has issued the text of a resolution of some length dealing with Lord Curzon's scheme for the reform of education. From this it appears that after an exhaustive history of the subject, the Government states that the existing methods require sweeping changes, and goes on to announce that competitive examinations for the public services will be abolished and a system of selection of candidates on probation substituted. "Examinations," it is added, "have harmfully dominated the education system." The Government admits that primary education has been neglected, while secondary education has increased in a striking manner. The college curriculum will be generally raised, the Government assisting deserving colleges. Teachers will be specially trained, and the Education Department will be given four extra officers to assist the present

directors. Questions relating to commercial, technical, artistic, and agricultural training are fully discussed in the resolution.

A NEW building, called Palmer Hall, which has been opened at Colorado College, Colorado, has cost more than 50,000*l.*, and is to be devoted chiefly to the scientific departments. The dedicatory address was delivered by the president of Stanford University, Dr. D. S. Jordan, who in the course of his remarks said :—"As the university ideal of England is one of personal culture, that of Germany is one of personal knowledge. An educated German may lack culture—of this there are many conspicuous examples, just as in England a cultured gentleman may lack exactness of knowledge on all points. In America, a new ideal is arising as a result of the creative needs of our strenuous and complex times. We value education for what can be made of it. Our idea is personal effectiveness. We care less and less for surface culture, less and less for mere erudition. We ask of each man not what he knows, but what he can do with his knowledge. This ideal of education has its dangers. It may lead us to sacrifice permanent values for temporary success. It may tend to tolerate boorishness and shallowness, if they present the appearance of temporary achievement. But the fact remains, the value of science lies in its relation to human conduct. The value of knowledge lies in the use we can make of it. As each thought of the mind tends to work itself out in action, so does each accession of human knowledge find its end in fitting men to live saner and stronger lives. We may, therefore, rest content with the ideal of effectiveness."

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, February 18.—"Note on the Formation of Solids at Low Temperatures, particularly with regard to Solid Hydrogen." By Morris W. **Travers,** D.Sc., Professor of Chemistry at University College, Bristol. Communicated by Sir W. Ramsay, K.C.B., F.R.S.

In the year 1902 Dr. Jaquerod and the author carried out some experiments on liquid and solid hydrogen with the view of determining its vapour pressure on the scales of the constant-volume helium and hydrogen thermometers. They found that hydrogen remained liquid down to 14°·2 (He scale), the lowest temperature to which they could reduce a large mass of the liquid by means of the pump at their disposal. When, however, a small quantity of liquid hydrogen, cooled to 14°·2 in a glass tube immersed in the liquid contained in the large vacuum vessel, was allowed to evaporate under reduced pressure, it solidified when the pressure fell to 49 or 50 mm. of mercury. This pressure corresponds to a temperature of 14°·1 on the helium scale. The presence of the solid was determined by mechanical means, and it was not possible to observe its appearance.[1]

Dewar gives the melting point of hydrogen at about 15° absolute, and the melting pressure at 55 mm. of mercury. He describes its appearance as that of "frozen foam," or as "clear transparent ice."[2]

It appeared to the author worth while to carry out a few experiments to try to determine whether solid hydrogen formed definite crystal, or, indeed, whether the glassy substance was a true solid or merely a highly viscous fluid. The following is an instance in which both such changes occur.

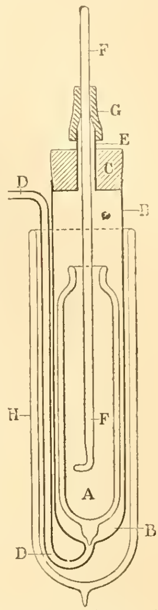
If an organic liquid, such as ethyl acetoacetate, is cooled slowly to the temperature of liquid air it is converted into crystalline solid, the formation of the crystals commencing when the liquid is cooled to about $-150°$ C., usually at several points on the side of the vessel, and spreading rapidly throughout the mass. If, on the other hand, the liquid is cooled very rapidly, a hard glassy substance is formed, and though crystals may begin to appear, they will only do so locally, as the velocity of crystallisation decreases rapidly as the viscosity of the liquid increases. The glassy substance is really a liquid of high viscosity; it is formed

[1] *Phil. Trans.*, A, vol. cc., p. 170.

[2] British Association, Presidential Address, 1902. See also paper on "Solid Hydrogen," Brit. Assoc. Report, 1899, reprinted in NATURE; also Roy. Inst. *Proc.*, 1900.

with perfect continuity from the normal liquid state, and should differ from the solid (crystalline) form in its physical properties. Such a substance might, for convenience, be called a pseudo-solid.

In the investigation of solid hydrogen the apparatus shown in the accompanying figure was employed. The liquid hydrogen was introduced into a small clear-glass vacuum-vessel 15 cm. long and 4 cm. in internal diameter. This vessel was placed inside a glass tube BB, which communicated with an exhaust pump through a tube DD sealed to it, and was closed by a rubber stopper C. A short glass tube E, 6 mm. in diameter, passed through the stopper, and through it passed the stirring rod FF. To allow of free rotating motion to the stirrer, and to make the apparatus gas-tight, a short piece of rubber tube G was passed over the end of the tube E and was wired to F. The lower part of the apparatus was contained within the vacuum vessel H, which contained a small quantity of liquid air.



When the liquid hydrogen was made to boil *in vacuo*, its temperature fell, but the liquid did not appear to become more viscous. At length films of a colourless glassy substance formed at the surface, and broke away as the bubbles rose. After a short time the vessel became filled with these flakes, and while in this condition stirring, by giving the top of the rod F a rotatory motion, did not appear to indicate that the portion which remained liquid had undergone any considerable increase in viscosity. After a time the mass contained so much solid that it became pasty, and finally the whole of it appeared fairly homogeneous.

The solid evaporated fairly rapidly, so that after about ten minutes only a hollow cylinder of it, about 3 cm. long and 2·5 cm. in diameter, remained. This had the appearance of a film of ice which had partly thawed, consisting of clear granules connected by thinner and less transparent portions of solid. No crystals were observed on either of the three occasions on which the experiments were carried out. An attempt was made to examine the solid in the field of a polariscope, but it was unsuccessful.

Though there is no direct evidence of the formation of crystalline hydrogen, the author's experiments lead to the belief that solid hydrogen is a crystalline substance and not a pseudo-solid. The sharpness with which the solid hydrogen is formed, and the constancy of the apparent melting pressure, are distinct evidence in favour of this conclusion, though it must be allowed that the rate of change in viscosity, when the temperatures are measured on the Centigrade scale, will probably appear to be more rapid at low temperatures than at high temperatures.

The whole question of the formation of solids at very low temperatures is of great interest both from a physical and from a biological standpoint. It is quite possible that if living organisms were cooled only to temperatures at which physical changes, such as crystallisation, take place with measurable velocity, the process would be fatal, whereas if they once were cooled to the temperature of liquid air, no such change could take place within finite time, and the organism would survive.[1]

These experiments were made in connection with some investigations which were being carried out at University College, London, with the assistance of a grant from the Royal Society. As the author is at present unable to continue the work, he has decided to publish this note.

[1] Experimental results are given by Macfadyen, Roy. Soc. *Proc.*, vol. lxvi., 1900, pp. 180, 339, 488; Swithinbank, Roy. Soc. *Proc.*, vol. lxviii., 1901, p. 502.

Geological Society, February 19.—Annual general meeting. Sir Archibald Geikie, F.R.S., vice-president, in the chair.—After the presentation of the annual awards, the chairman proceeded to read the anniversary address that he had prepared, giving first of all obituary notices of several fellows deceased since the last annual meeting. He then dealt with the bearing of the evidence furnished by the British Isles as to the problem whether in the so-called secular elevation and subsidence of land it is the land or the sea which moves. The conclusion thus reached was in favour of the generally accepted view that changes of level, such as those of Pleistocene and post-Pleistocene time, in the British area, have been primarily due, not to any oscillation of the surface of the ocean, but directly to movements of the terrestrial crust.

February 24.—Dr. J. E. Marr, F.R.S., president, in the chair.—Eocene and later formations surrounding the Dardanelles: Lieut.-Colonel T. **English**, late R.E. Our present knowledge of the older rocks, upon which the Tertiary beds surrounding the Dardanelles rest, only suffices to indicate the positions of the outcrops of a succession of schists, crystalline limestones, granites, and serpentines, which can be traced from the Ægean district into the Marmora, where they formed an archipelago in the Eocene Sea. The Eocene deposits surrounding these old rocks commence with sandstones, conglomerates, and clays, which become calcareous and nummulitic upward, and are about 2000 feet thick in the aggregate. They are succeeded by 3000 feet of lacustrine sandstones, clays, and schists, interstratified with volcanic rocks, and containing coal-seams. These beds have yielded Anthracotherium, plant remains, and *Corbicula semistriata* at the coal-horizon, which is near the middle of the series. They are widely spread in southern Thrace, and are cut off to the eastward by the falling-in of the Marmora sea-bed. The author has traced them along the Gallipoli Peninsula to Imbros Island; Lemnos and Samothrake are partly composed of similar beds, and he considers that all these deposits represent the uppermost Eocene and the Oligocene, and that the coal-seams belong to the latter. The paper is accompanied by three appendices, one on the rock-specimens, by Dr. J. S. Flett; one on the collection of Tertiary and post-Tertiary fossils, by Mr. R. Bullen Newton; and a third, by Mr. R. Holland, on species of Nummulites.—The Derby earthquakes of March 24 and May 3, 1903: Dr. Charles **Davison**. The undoubted earthquakes of this series were four in number. The first and strongest occurred on March 24, 1903, at 1.30 p.m., and was felt over an area of about 12,000 square miles, its centre coinciding with the village of Kniveton, near Ashbourne. The shock consisted of two distinct parts, separated by an interval of about three seconds, which coalesced, however, within a narrow rectilinear band running centrally across the disturbed area at right angles to the longer axes of the isoseismal lines. The isacoustic lines (or lines of equal sound-audibility) are very elongated curves, distorted along the rectilinear band. The earthquake, it is concluded, was caused by simultaneous slips within two detached foci situated along a fault-surface running from north 33° east to south 33° west, hading to the north-west, and passing close to the village of Hognaston. The strongest after-shock occurred on May 3, its focus lying along the same fault, for the most part between the two foci of the principal earthquake, but much nearer the surface. The principal earthquake was registered by an Omori horizontal pendulum at Birmingham, by a Milne seismograph at Bidston (near Birkenhead), and by a Wiechert pendulum at Göttingen (502 miles from the epicentre). The larger waves travelled with a velocity of 2.9 kilometres per second.

Chemical Society, March 3.—Dr. W. A. Tilden, F.R.S., president, in the chair. The following papers were read:—Chemical dynamics of the alkyl iodides: Miss K. A. **Burke** and F. G. **Donnan**. The authors have determined the velocity of the reaction between silver nitrate and various alkyl iodides in alcoholic solution, and have compared the results so obtained with those observed by previous workers using other reactions of the alkyl haloids.—Separation of β-crotonic acid from α-crotonic acid: R. S. **Morrell** and A. E. **Bellars**. This separation was effected by recrystallisation of the quinine salts of the mixed acids.—Contribution to the knowledge of the β-diketones: S. **Ruhemann** and E. R. **Watson**.—Purification of water by continuous fractional distillation: W. R. **Bousfield**. The apparatus consists of a copper boiler provided with a series of "baffle plates" to prevent "spraying," leading to a condenser consisting of a series of test-tubes cooled by adjustable streams of water at different temperatures. The distilled water which drips from the coldest portions of the condenser is sufficiently pure to be used in electrical conductivity experiments.—Freezing point curves of dynamic isomerides. Ammonium thiocyanate and thiocarbamide: A. **Findlay**. The freezing point curve consists of two branches meeting at the eutectic point 104.3.—Constitution of phenolphthalein: A. G. **Green** and A. G. **Perkin**. δ-Ketohexahydrobenzoic acid: W. H. **Perkin**, jun.—Photochemically active chlorine: C. H. **Burgess** and D. L. **Chapman**.—The union of hydrogen and chlorine, part viii., the action of temperature on the period of induction: J. W. **Mellor**. It is shown that the period of induction shortens with increase of temperature up to 38°; above this point the temperature effect is obscured, probably by the influence of the water vapour present.—The union of hydrogen and chlorine, part ix., further experiments on the action of light on chlorine: J. W. **Mellor**. It is shown that the greater chemical activity of "insolated" chlorine is closely related with the presence of water vapour.—Additive compounds of unsaturated cyclic ketones with hydrogen cyanide: A. C. O. **Hann** and A. **Lapworth**. A description of the additive compounds obtained from carvone and pulegone.—Formation of periodides in organic solvents: H. M. **Dawson**. A study of the potassium periodides formed by the solution of potassium iodide and iodine in organic aromatic and aliphatic solvents.—The action of sodium hypochlorite on the aromatic sulphonamides: H. S. **Raper**, J. T. **Thompson** and J. B. **Cohen**. A description of the compounds obtained.

Linnean Society, March 3.—Prof. S. H. Vines, F.R.S., president, in the chair.—Mr. L. A. **Boodle** exhibited photographic lantern-slides demonstrating the formation of secondary wood in certain regions of the stem of *Psilotum triquetrum*.—List of the Carices of Malaya: C. B. **Clarke**, F.R.S. After defining his meaning of the term Malaya, the author explained that he had been obliged to confine his remarks to the material existing at Kew, with certain additional specimens lent by Dr. Zahlbruckner, of Vienna, who had sent over some of the types of Zollinger's collections. The British Museum herbarium could not be utilised, owing to the impracticability of comparing the specimens belonging to the two institutions. In all, fifty-four species are here enumerated, of which thirty-six, including the eleven here characterised as new, belong to the subgenus Caricandra, a natural group essentially tropical and difficult to diagnose as to species, all possessing a trifid style, with a terminal spike male in the upper portion and female at the base.—On some species of the genus Palæmon, Fabr., from Tahiti, Shanghai, New Guinea, and West Africa: Dr. J. G. **de Man**.—The species discussed are distributed by the author over three subgenera. Relative measurements and minute details of various specimens are explained and illustrated by drawings, to show the amount of variation possible among examples undoubtedly belonging to a single species, and on the other hand to offer materials for deciding whether forms from two or more widely separated localities should be accepted as specifically identical.

Mathematical Society, March 10.—Dr. E. W. Hobson, vice-president, and temporarily Prof. Elliott, vice-president, in the chair.—The following papers were communicated:—On inner limiting sets of points in a linear interval: Dr. E. W. **Hobson**. Every point of an inner limiting set may be enclosed in a sequence of intervals of breadths tending to zero in such a way that those limiting points of the set which do not belong to the set are not, in the limit, interior points of any of the intervals. The cardinal number of the points of an inner limiting set is known to be either that of the natural numbers or that of the continuum. It is shown in the paper that the necessary and sufficient condition that an enumerable set may be an inner limiting set is that it contains no component which is dense in itself. The most general character of an inner limiting set which is unenumerable is also determined. The importance of the

theory in connection with functions of real variables is explained.—On the unique expression of a quantic of any order in any number of variables with an application to binary perpetuants: P. W. **Wood.** The paper contains a new proof that the minimum weight of an irreducible perpetuant of degree δ is $2^{\delta-1} - 1$.—(1) The derivation of generalised Bessel coefficients from a function analogous to the exponential; (2) transformation of generalised Legendre functions: Rev. F. H. **Jackson.** In a series of papers the author has shown how functions defined by known power series may be generalised by replacing the numbers $1, 2, \ldots n$ in the coefficients by the numbers $p_1, p_2, \ldots p_n$ of a chosen sequence. The two papers now communicated trace various analogies between Bessel functions and Legendre functions and the functions that are derived from them by this process.—The singularities of functions defined by power series: H. M. **Macdonald.**—Illustrations of modes of decay of vibratory motions: Prof. A. E. H. **Love.** The ordinary processes for determining the rate of decay of vibratory motion by transmission of waves through the surrounding medium afford a good approximation when the rate in question is slow, but they are inadequate for determining the motion of the medium. It is shown that when a sphere vibrates in air the slightly damped harmonic wave, with nearly the period of the vibrator, must be accompanied in its passage through the air by one or more subsidiary waves, of exponential or rapidly damped harmonic type, which serve to establish the front of the advancing wave. When electrical oscillations are set up on a spherical conductor, the waves that travel through the æther are analogous to the subsidiary waves in the sound problem. Corresponding with any surface harmonic distribution of the initial charge a system of such waves advances into the initial electrostatic field of the distribution, and all the waves of the system must coexist in order that the wave-front may advance. The wave-motions cannot be propagated independently. As the front of the composite system of waves advances the electrostatic energy of the initial field is converted into electromagnetic energy, which is accumulated in a narrow region at the front of the advancing wave.

EDINBURGH.

Royal Society, February 1.—Lord Kelvin, president, in the chair.—The **President** read a paper on deep-water two-dimensional waves produced by any given initiating disturbance, which was in continuation of a paper on the front and rear of a free procession of waves in deep water, read seventeen years ago. In that paper a question had been raised and a solution given in symbols which still, however, awaited tabulation or graphical calculation. The problem of the surface motion of waves in very deep water had long been solved, but the problem of waves circling out in all directions from the surface disturbance produced by the falling of a stone into the water was a far more difficult problem, which nothing known in mathematics enabled the mathematician to calculate. In the present paper Lord Kelvin gave the solution of an analogous though simpler problem. Given a certain definitely specified initial disturbance fitted to generate two-dimensional wave motion, the results showed the genesis of waves from a condition in which there was nothing undulating whatever.—Dr. G. A. **Berry** read a paper on the relation of visual efficiency to visual acuity, being a consideration of the data for determining in general the relative loss of efficiency caused by accidents which lead to different degrees of interference with sight. The object was to get some basis for calculating the amount of compensation which should be allowed by the Workman's Compensation Act when sight had been damaged to various extent by accident, and thus avoid the frequent litigation to which such accidents now give rise. The data for establishing a visual efficiency scale were somewhat arbitrary, but basing on certain principles, the author deduced the following expression for the efficiency:—

$$E = \frac{m + 1 - \dfrac{V+V'}{2} - \dfrac{V-V'}{V+V'}\left(1 - \dfrac{V+V'}{2}\right)}{m - 1 + 2/(V+V')}$$

where V, V′ were the visual acuities of the better and worse eyes respectively, and m a number such that the fraction $m/(m+1)$ represented the reduction in sight due to complete loss in one eye with retention of full sight in the other. Tables of efficiency were given for different values of m, also maximum and minimum curves for $m=3$.

February 15.—Dr. Horne in the chair.—Dr. T. J. **Jehu** read a paper on the Glacial deposits of northern Pembrokeshire, in which full descriptions were given of (1) the lower Boulder-clay; (2) the sands and gravels; (3) the upper Boulder-clay and rubbly drift. Boulders from the south of Scotland and the north-west of Ireland were found, showing that the northern ice-sheet had covered the whole of north Pembrokeshire. The results led to a clearer view than had been possible hitherto as to limits of the various ice sheets which glaciated that region.—In a communication on sea temperature and solar radiation, Prof. C. G. **Knott** discussed some of the data furnished by the elaborate observations of temperature at various depths in the Mediterranean Sea made by the staff of the Austrian warship *Pola.* It was shown that direct solar radiation was not appreciable to depths greater than 15 metres, and that the vertical distribution of temperature within the upper layers was largely conditioned by convection or diffusion of material. An estimate was made of the amount of solar heat which gets into the water every day and leaves it at night, and it was found that about two-thirds of the available solar energy incident on the surface of the waters was so entrapped and set free. The processes by which this diurnal influx and efflux of heat took place were discussed in some detail.

PARIS.

Academy of Sciences, March 7.—M. Mascart in the chair. The president announced the death of M. Fouqué, member of the section of mineralogy.—Researches on the gaseous exchanges between the atmosphere and plants deprived of their roots, and kept in the dark: M. **Berthelot.** The gases given off during the maturing of hay were measured, together with the rise of temperature. Neither methane nor ammonia were given off, the gases containing carbon dioxide, oxygen, and nitrogen only.—On the rhizomes and roots of the fossil ferns and of the Cycadofilices: M. **Grand'Eury.**—On the formation of glycuronic acid in the blood: R. **Lepine** and M. **Boulud.** The authors have shown in a previous paper that glycuronic acid is present in the liver, and now give experimental evidence that the lævorotatory power of certain extracts of blood from the hepatic veins is due to derivatives of this acid.—M. Agassiz was elected a foreign associate in the place of the late Sir George Gabriel Stokes, and M. Warming a correspondant in the section of botany in the place of M. Agardh.—The dielectric cohesion of argon and its mixtures: E. **Bouty.** Argon is characterised by the smallness of its dielectric cohesion, which is even less than that of hydrogen. Minute traces of foreign gases produce a remarkable increase in the cohesion, this increase being much greater than would be indicated by the law of mixtures.—The general law of magnetofriction: H. **Pellat.** In an intense magnetic field the particles in motion, the kathode rays, undergo an action analogous to an anisotropic friction, which is large in a direction perpendicular to the lines of force, but almost nothing in the direction of these lines. Experimental proofs of the laws of anomalous propagation of light along the axis of an optical instrument: G. **Sagnac.**—An elementary demonstration of the phase rule: C. **Raveau.**—The different conditions of a spark fractionated by blowing: J. **Lemoine** and L. **Chapeau.** When a stream of sparks is allowed to pass over a spark gap for some time, there is an abrupt change in the nature of the discharge. This is due to the spontaneous oxidation of the brass, the formation of oxide causing a lower explosive potential than with polished brass balls.—The action of certain chemical and osmotic phenomena on phosphorescence: M. **Lambert.**—On europium: G. **Urbain** and H. **Lacombe.** The authors have applied their method of crystallisation with magnesium and bismuth nitrates to the separation of europium (Demarçay) from monazite sand. The sand contains only about 0·002 per cent. of this oxide, which forms a sulphate $Eu_2(SO_4)_3.8H_2O$. The atomic weight was found to be 151·8.—The action of carbon dioxide upon the metal ammoniums: Étienne **Rengade.** Carbon dioxide reacts with sodium-ammonium and potassium-ammonium. Below $-50°$ C. the alkaline carbamate and hydrogen are the sole products. At a higher temperature

some formate is also produced.—A general method for the preparation of anhydrous chlorides: C. **Matignon** and F. **Bourion.** A mixture of chlorine and sulphur chloride reacts with metallic oxides at moderately low temperatures, giving an anhydrous chloride. Details are given of the preparation of the chlorides of silicon, aluminium, thorium, praseodidymium, neodidymium and samarium.—On the phenylurethanes of the sugars: L. **Maquenne** and W. **Goodwin.**—On allyl- and propenyl-alkyl ketones: E. E. **Blaise.** In the allyl-alkyl-ketones, migration of the ethylene linkage occurs with extreme facility, and details are given of the various ways in which this may be effected.—The combination of saccharose with some metallic salts: D. **Gauthier.**—On the development of annual oil-containing plants: G. **André.**—On the development of the perithecium in the Ascomycetes: P. A. **Dangeard.**—On the perpetuation of the mildew of the vine: Gy **de Istvanffi.** The author has been able to prove the presence of the mycelium in a latent state in several organs of the vine during the winter months.—Faults and folds: H. **Douvillé.**—On the chemical composition of the crystalline strata of the Belledonne Chain: Pierre **Termier** and André **Leclère.**—The action of the n-rays upon the sense of hearing: Augustin **Charpentier.** The sensibility of the ear is increased when acted upon by the n-rays.—The physiological action of the n_1-rays of Blondlot: Augustin **Charpentier.** M. Blondlot has recently described a new species of rays possessing physical properties which are the inverse of the n-rays previously studied. These rays also produce the inverse effects on the nervous system; thus they diminish the intensity of the sensation of smell, whereas the n-rays increase it.—On the relations of the colouring matter of subrenal extract with tyrosine: Gab. **Bertrand.**—The oxidation of formic acid by extracts of animal tissues in presence of hydrogen peroxide: F. **Battelli.**—The action of artificial oxydases upon the tetanic toxin: Aug. **Lumière,** L. **Lumière** and J. **Chevrottier.**

DIARY OF SOCIETIES.

THURSDAY, MARCH 17.

ROYAL SOCIETY, at 4.30.—Physical Constants at Low Temperatures. (1) The Densities of Solid Oxygen, Nitrogen, Hydrogen, &c.: Prof. J. Dewar, F.R.S.—The Specific Heats of Metals, and the Relation of Specific Heat to Atomic Weight. Part III.: Prof. W. A. Tilden, F.R.S.—On the Construction of some Mercury Standards of Resistance, with a determination of the Temperature Coefficient of Resistance of Mercury: F. E. Smith.—On the Effect of a Magnetic Field on the Rate of Subsidence of Torsional Oscillations in Wires of Nickel and Iron, and the Changes produced by Drawing and Annealing: Prof. A. Gray, F.R.S., and A. Wood.—On a Criterion which may serve to test various Theories of Inheritance: Prof. K. Pearson, F.R.S.

LINNEAN SOCIETY, at 8.—On the Bryozoa from Franz Josef Land: A. W. Waters.—Natural-Colour Photographs of Living Insects and Flowers: F. Enock.

AERONAUTICAL SOCIETY, at 8.—Experiments with Aerial Screw Propellers: Major B. F. S. Baden-Powell.—The Beedle Airship: W. Beedle.—Mechanical Flight: Thomas Moy.

INSTITUTION OF MINING AND METALLURGY, at 8.—Annual General Meeting. Followed by Discussion on "The Equipment of Laboratories for Advanced Teaching and Research in the Mineral Industries."

FRIDAY, MARCH 18.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—Compound Locomotives in France: M. Edouard Sauvage.

EPIDEMIOLOGICAL SOCIETY, at 8.30.—The Epidemiology of Enteric Fever and Cholera in Hamburg: Dr. Reincke.

SATURDAY, MARCH 19.

ROYAL INSTITUTION, at 3.—The Life and Work of Stokes: Lord Rayleigh.

MONDAY, MARCH 21.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—The Swedish Antarctic Expedition: Dr. Otto Nordenskjold.

FARADAY SOCIETY, at 8.—The Electrolytic Analysis of Gold: Dr. F. Mollwo Perkin and W. C. Prebble.—Thin Film Electrolysis with an Application to Printing: Chas. R. Darling. (With Experiments.)

SOCIETY OF ARTS, at 8.—Recent Advances in Electro-Chemistry: Bertram Blount. (Cantor Lecture, III.)

SOCIETY FOR PSYCHICAL RESEARCH, at 8.30.—A Case of Multiple Personality: Dr. A. Wilson.

TUESDAY, MARCH 22.

ROYAL INSTITUTION, at 5.—The Doctrine of Heaven and Hell in Ancient Egypt and the Books of the Underworld: Dr. E. A. Wallis Budge.

SOCIETY OF ARTS, at 4.30.—Cotton Growing in the British Empire: Alfred Emmott, M.P.

INSTITUTION OF CIVIL ENGINEERS, at 8.—*Discussion*: The Barrage across the Nile at Asyut: G. H. Stephens, C.M.G.—The Use of Cement Grout at the Delta Barrage in Egypt: Sir R. H. Brown, K.C.M.G.—*Papers*: Lowering the Sill of the Ramsden Dock, Barrow-in-Furness: L. H. Savile.—Burntisland Harbour; Construction of the East Dock: R. Henderson.

MINERALOGICAL SOCIETY, at 8.—(1) Irregularly Developed Crystals of Zircon (Specific Gravity 4·0) from Ceylon; (2) Notes on "Feather-ore"; identity of "Domingite" ("Warrenite") with Jamesonite: L. J. Spencer.—The Connection between the Atom Arrangements of certain Allied Carbon Compounds: W. Barlow.—On the Construction and Use of the Moriometer: H. Smith.—(1) Note Relative to the History of the Caperr Meteorite; (2) On the Meteoric Irons of Bethany, Lion River, Springbok River and Great Fish River, South Africa: L. Fletcher, F.R.S.

WEDNESDAY, MARCH 23.

GEOLOGICAL SOCIETY, at 8.—On the Discovery of Human Remains beneath the Stalagmite Floor of Gough's Cavern, near Cheddar: H. N. Davies.—On the Moine Gneisses of the East Central Highlands and their Position in the Highland Sequence: G. Barrow.

THURSDAY, MARCH 24.

ROYAL SOCIETY, at 4.30.—Croonian Lecture, on the Chemical Regulation of the Secretory Process: Prof. E. H. Starling, F.R.S., and Dr. W. M. Bayliss, F.R.S.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Direct Reading Measuring Instruments for Switchboard Use: K. Edgcumbe and F. Punga.

FRIDAY, MARCH 25.

ROYAL INSTITUTION, at 9.—Liquid Hydrogen Calorimetry: Prof. Dewar, F.R.S.

PHYSICAL SOCIETY, at 5.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Relative Advantages of Continuous and Alternating Current for Traction Purposes: J. M. Kennedy.

SATURDAY, MARCH 26.

ROYAL INSTITUTION, at 3.—The Life and Work of Stokes: Lord Rayleigh.

CONTENTS.

THURSDAY, MARCH 24, 1904.

DIVERS MEN AND MATTERS.

Essays and Addresses, 1900–1903. By the Right Hon. Lord Avebury, P.C. Pp. 296. (London: Macmillan and Co., Ltd., 1903.) Price 7s. 6d. net.

INCLUDED in this volume are short studies of the life and work of Huxley, Ruskin, Richard Jefferies, and Macaulay; speeches on the institution of Bank Holidays, and the Early Closing Bill for Shop Assistants; three papers on trade and commerce; three addresses on education; and three other papers.

The first paper gains in interest from Lord Avebury's personal acquaintance with Huxley. The author gives an appreciation of the man as well as of his work. They were associated in the foundation of the Anthropological Institute, on commissions on scientific instruction, in the Metaphysical Society, and as members of the X Club, which included also Hooker, Spencer and Tyndall. Lord Avebury deals with Huxley's work in natural science, in education, and in metaphysics. Huxley was foremost in showing the fascination of scientific study. As Sir Michael Foster says, "Whatever bit of life Huxley touched—and there were few living things he did not touch—he shed light on it and left his mark." As to education, Huxley was a member of the first London School Board, where he made valuable suggestions as to the moral, physical and domestic, as well as to the intellectual and scientific training of the young. His attitude is well illustrated by his saying, "Teach a child what is wise—that is morality; teach him what is wise and beautiful—that is religion." In the Metaphysical Society, Huxley had difficulty in ranking himself. "Most of my colleagues were 'ists' of one sort or another; and, however kind and friendly they might be, I, the man without a rag to cover himself with, could not fail to have . . . . uneasy feelings. . . . So I took thought, and invented what I conceived to be the appropriate title of agnostic." He described his position as being "Not among fatalists, for I take the conception of necessity to have a logical, and not a physical, foundation; not among materialists; for I am utterly incapable of conceiving the existence of matter if there is no mind in which to picture that existence; not among atheists, for the problem of the ultimate cause of existence is one which seems to me to be hopelessly out of reach of my poor powers."

It may not have been possible to deal fairly with the work and personality of so many-sided a genius as Ruskin in one short lecture, but it was surely unnecessary to have spent so much care in showing the inconsistencies and paradoxes with which Ruskin delighted to adorn his writings, to the exclusion of his positive and essential teaching; and Lord Avebury himself asserts that the spirit of the critic, always of more importance than the letter, is true and noble. Fortunately, Ruskin's attitude towards art is not dealt with, but the paper is completed with some of Ruskin's exquisite descriptions of plants, animals, water and mountains.

The paper on Richard Jefferies is appreciative and interesting, and it is a happy conjunction that he is placed after Huxley and Ruskin. While Huxley compelled Nature to yield her secrets to his analysis, and Ruskin depicted her with his marvellous skill as a word-painter, Jefferies approached her with the passionate rapture of a lover, and lived with her in intimate study of all her secret moods.

But perhaps Lord Avebury is more interesting in his capacity of social reformer than as literary critic. He gives the history of the initiation of Bank Holidays, and dwells on the advantage of the uniformity which allows members of one family scattered in different occupations a possibility of periodic reunion. The plea for legislation for early closing, which follows, is forcible and convincing; the general need and demand for shorter hours is evident, and so is the impossibility of any sufficient reform on voluntary lines.

In the paper on British commerce, written before the fiscal controversy became acute, Lord Avebury supports the optimistic view that we have made rapid progress, and that there is no "reason for despondency or discouragement" as to the future, if we improve our national education, practise economy in national expenditure, and improve the relations between capital and labour. As regards the last, however, he does not get beyond the somewhat obvious remark that "In the interests alike of employers and employed it will be well if wiser and more conciliatory counsels prevail in the future." In dealing with fiscal policy, Lord Avebury has many telling illustrations of the advantages of free trade, and gives some very important evidence as to the difficulties which Germany finds in the Kartell system; but his paper will not be in any way convincing to the advocates of an Imperial fiscal policy, for he does not come to close quarters with their ideas and arguments. The paper is loose both in style and logic; what are we to think of a writer who holds that Canada's preference to us is a dominant cause of the migration from the United States to the North-West Provinces. "I am very pleased to see that Canada has herself benefited by the reduction. Our trade has increased 3,000,000*l*. with Canada, and the result to Canada has been that her people have got an increased supply of cheap goods, her agriculture has benefited, farmers are flocking in from the United States."

The eleventh paper is an attack on municipal trading. It is not possible to deal with so highly controversial a subject in our present space. The most is made of the difficulties, risks, dangers and possible loss when municipalities undertake work which private enterprise could do as well, and these will be admitted by most unprejudiced students; but no real help is given to the very real difficulty of laying down principles which should govern municipal action. Such a paragraph as follows hardly shows a scientific view of a complicated economic problem:—

"As regards the telegraphs, it is sometimes said that though we have paid dearly for it, at any rate we have a more effective system. This is, of course, a matter of opinion, but I doubt it. My belief is that competition would have given us a better system. This cannot be proved, but I may give an illustration . . . ."

The papers on education derive interest from Lord Avebury's position on three commissions and in the University of London, and form a strong and convincing argument in favour of the increased attention to science which we may hope is gradually finding place; they are marked by the aptly selected quotations for which readers of "The Pleasures of Life" are prepared.

When a writer publishes essays on so wide a range of subjects, he deliberately invites criticism; and, indeed, readers of this volume will ask in several cases whether this or that address was worth printing. But if the papers are not taken too seriously, much will be found of interest, if little that is new. The book resembles the modern daily paper in many other respects; there is a wide range of ideas, something for everybody, much hasty writing, and frequent repetition of the same items in different guises.

IN SEARCH OF TRUTH.

Humanism: Philosophical Essays. By F. C. S. Schiller, M.A. Pp. xxvii+297. (London: Macmillan and Co., Ltd.; New York: The Macmillan Company, 1903.) Price 8*s.* 6*d.* net.

Ueber die Grenzen der Gewissheit. By Dr. Ernst Dürr. Pp. vii+152. (Verlag der Dürr'schen Buchhandlung, 1903.) Price 3.50 marks.

Tat und Wahrheit. Eine Grundfrage der Geisteswissenschaft. By Hans von Lüpke. Pp. 35. (Leipzig: Verlag der Dürr'schen Buchhandlung, 1903.) Price 50 pf.

Proceedings of the Aristotelian Society. New Series. Vol. iii. (London: Williams and Norgate, 1903.) Price 10*s.* 6*d.*

THE collection of articles and addresses presented in Mr. Schiller's volume exhibits all the characteristics familiar to readers of his previous work. Paradox is, of course, not wanting; humour enlivens discussion, not shrinking from the antithesis of "comic" and "cosmic," or such a phrase as "ponderous pondering"; philosophy, literary criticism, and the Psychical Research Society are duly represented. Mr. Schiller's style incurs one great disadvantage: it sometimes leaves the reader in doubt whether the matter is really to be taken seriously; perhaps this is why Mr. Schiller has still to complain that philosophers neglect his imperatives.

The keynote to the book is pragmatism, and the essays here collected may claim the unity of this one theme. The parts vary considerably both in quality and subject. The essay in literary criticism, "Concerning Mephistopheles," may claim a first place; it is interesting, novel and lucid, in short, our author at his best. The first eight essays, dealing with some of the most vexed questions of philosophy, have common characteristics and equal value. Mr. Schiller triumphs in destructive criticism; the common-sense element of pragmatism is, in his hands, a powerful weapon against extravagances not unknown in recent philosophy; pragmatism is thus justified as a tonic; if we object that man does not live by tonics, we are again victims of a triumph, for a collection of essays is not a system and not open to a systematic criticism. The essay on "Reality and 'Idealism'" illustrates the first point; for the second, let the dialogue on "Useless Knowledge" plead its occupancy of space. One of the most satisfactory essays is "Darwinism and Design," and "Pessimism" is a subject which, directly and indirectly, inspires some of the best passages in the book. The closing sections on "Immortality" would call for no remark except that such a subject too often attracts the uncritical; even they will probably think Mr. Schiller's concept of "spirit" might have been definitely explained, while his admission that the "state after death" does not form a part of the experience of any subject in the sense that "real" and "dream" states do, might well have excused not a few of the closing pages. One thing more is also a desideratum: that concept of "purpose" on which pragmatism bases its claim to rejuvenate philosophy must be elaborated; for this we wait, not without fasting, taking the present contribution as earnest of the systematic exposition which the introduction seems to promise.

As the title denotes, Dr. Dürr's book deals with the question of boundaries, consequently it is critical rather than constructive, negative rather than positive. The central problem is, How much may be called certain? and, from the author's point of view, the immediately given is alone fully certain. The immediately given is the psychical actuality. But we cannot rest in this; problems arise which compel us to make distinctions; even consistency cannot ensure "reality," for dreams may be consistent and yet life is more than a dream.

It appears then that the necessity of the immediately given coexists with a necessity for that which is not immediately given, but that which is not immediately given has not certainty—it is the object of belief and is not justified by any formal logical proof, but by the worth which attaches to our conception of it. Realism, for example, is without proof, but it is right as against anti-realism by virtue of its superior value as a basis for science.

Having thus found belief at the very roots of science we may consider some belief to have some certainty; we may further show that other beliefs, ethical and metaphysical, are not less certain than this scientific belief, and with that the limit of our author's work is reached. The result is a defence of belief against some, and only some, attacks. It might be objected that the ethical belief cannot be defended by proving it not less valuable than the scientific belief without giving the concept of value an ambiguous significance. The preliminary discussions on "Erkenntnistheorie" and the question of a "Kriterium" contain much interesting criticism; but the subsequent justification of belief seems built on inadequate foundations.

The subject of Herr Lüpke's little book is the significance of genius; the basis from which the subject is developed is the work of Eugen Kühnemann. The exposition of Kühnemann's importance is combined with original suggestions, but the author admits that no exact distinction between these parts can be made. The point selected for emphasis is the method adopted by Kühnemann of studying thought in a concrete way; to understand a thinker we must study the life-history of his thought, exposing the soil and climate of its growth. This scientific analysis has been applied by Kühnemann in his works on Socrates and Herder. The result is a more adequate recognition of personality as the object of Geisteswissenschaft and a clearer idea of the meaning of personality. From this certain deductions follow. Genius means the ability adequately to express oneself; it implies a penetration into the very depths of our own being—and, consequently, a power to reach the depths common to all humanity. In both aspects, whether of the method by which we interpret the thought or of the manner in which the thought expresses the being of the thinker, it is equally true to say that thus the word becomes flesh.

The author is here very much in touch with the significance which recent writers in Germany give to the term "Geisteswissenschaft." He has a further interest in relating this movement to theology and the progress of scientific theology. The point that in the life of genius the word becomes flesh, indicates the direction in which we are to look for the expected development. The author makes the noteworthy remark that the battle for a God is not to be fought in the sphere of natural science, but in this study of personality. Though brief, the essay is singularly suggestive.

The published proceedings of the Aristotelian Society are always of considerable interest. If comparison is permitted, the contributions to this number seem more than usually interesting, while the whole series is pervaded with an atmosphere of life and activity. The first paper is an able criticism of "Mr. Bradley's Theory of Judgment" by Prof. Stout, whose work Dr. Bosanquet rightly says is "always thorough and of the highest scientific quality." The essay on "The Logic of Pragmatism" (Henry Sturt) is a timely contribution on a subject that at present stands in some need of complete exposition. Prof. Latta's treatment of "The Significance of the Sub-conscious" is a distinctly helpful contribution, marked by a lucidity too rarely associated with his subject; a little infusion of this same quality would have achieved something toward making the contribution of another writer ("Experience and Empiricism") more intelligible.

In all there are eight papers, and all are worth reading. In view of the quality of the work, it seems a pity that the Society should have to record a decrease in membership. This is certainly "matter for regret," and however much the spirit of the times is opposed to the speculative life, there must be many students of philosophy who do not support the Society; to such this volume should be an eloquent proof of the advantages of cooperation in the search after truth. G. S. B.

PEAKS AND PASSES OF GREECE.

Vacation Days in Greece. By Rufus B. Richardson, formerly Director of the American School of Archæology, Athens. Pp. xiii+240; illustrated. (London: Smith, Elder and Co., 1903.) Price 7*s.* 6*d.*

THE genial personality of the late director of the American School at Athens is known to everyone who has made any long stay in the capital of Greece during the past five years and more. No foreign resident, except, perhaps, Dr. Dörpfeld, had wider personal knowledge of the Hellenic peninsula than Mr. Richardson. Certainly none had pushed a bicycle over so many stony passes, or scaled half as many storied peaks. He made mountain-climbing a speciality of the American School, so much so that climbing of all kinds became a passion of the students; and while one risked life and limb on the Acropolis precipice to rediscover inscriptions once read by Wordsworth in the face of the Kimonian walls, another swung himself over the eastern pediment of the Parthenon to decipher by the print of the nails the dedication whereby a Roman emperor had aspired to appropriate the credit of the temple. In the pleasant volume before us Mr. Richardson describes two ascents, those of the highest peaks of Taygetus and Kióna, the less known twin of Parnassus, which overtops by about two hundred feet all other summits on Greek soil. But he alludes to many others, *e.g.* those of Parnassus itself and Aroania, and probably, with the exception of Tsumerka and the Pindus peaks, which are as much in Turkey as Greece, he has stood on every one of the mountain giants of free Hellas.

Despite Mr. Richardson's enthusiasm for the bicycle, few visitors, we suspect, will be convinced that it is the best vehicle for touring about Greece. A comparatively freshly laid road in the Hellenic kingdom is good enough, but very few are freshly laid, and an old road can be appalling. Then there are the dogs, and the impossibility of obtaining skilled surgery for the wheel outside Athens itself, and the chance of an occasional row with some rustic, whose dog you have had to stone, or whose mule has stampeded at sight of you. Nevertheless, given a light and inexpensive American machine, one may certainly get over most unpromising ground with it, and cover great distances in the day, freed from the intolerable irksomeness of sitting a Greek baggage-animal. Mr. Richardson's account of his three days' run from Athens to Thessaly is exhilarating reading; but did he really see Olympus from Cithaeron? Was it not rather some snowy part of Othrys or Pindus? The interval, from the point on which he was standing, to the seat of the gods, is not less than one hundred and fifty miles as the crow flies, and there are many intervening heights.

Mr. Richardson is careful to suppress archæological "shop," and to preserve the holiday atmosphere. Therefore, although he gives a glimpse of M. Kabbadias at work at Epidaurus, and alludes to the French excavations at Delphi, his own at Corinth, and others, his book is to be read, not for its information about these, nor, indeed, for scientific information of

any sort, but for its revelation of the matchless mountain and marine scenery of Greece, Sicily, and the Adriatic coast, for its breaths of an intoxicating air, and for the side-lights it throws on Greek peasant interiors and a rural life, which few foreigners have seen as often, and known as intimately, as our author. He shows himself typically American, restless, strenuous, adventurous, claiming the right to go everywhere and do everything, within the physical capacity of a man, but at the same time in singular sympathy with a land and people so little like his own. The book is very pleasant reading for all who know Greece, and should serve to excite many, who do not, to visit one of the loveliest lands on earth. D. G. H.

OUR BOOK SHELF.

Ueber verschiedene Wege phylogenetischer Entwickelung. By Prof. O. Jaekel, Berlin. Pp. 60; 28 figures. (Jena: Gustav Fischer, 1902.) Price 1.50 marks.

THERE are three dominant ideas in this notable essay, each requiring for the exposition it merits more space than our limits admit of.

(1) Besides the gradual changes with which we are all familiar, there have been what Galton called "transilient" transformations ("saltatory variations," "sprungweise Umbildungen"). By individual variation within one generation or within a few generations, certain animal organisms have undergone profound transformations, comparable to the "mutations" described in plants by Korschinsky and de Vries. This is an important conclusion, the evidence for which is palæontological. Prof. Jaekel distinguishes what may be called three grades of variation:—(*a*) the so-called normal range of variation, changes in the proportions and correlations of the structural architecture, limited in final result by the conditions of inter-crossing; (*b*) abrupt deviations which transcend the limits of structural correlation and cannot be harmonised with the organic unity, which are therefore called "anomalies" or pathological aberrations from the evolutionary trend of the species; (*c*) transilient deviations or mutations which bring about a new system of correlations, what others have called "a new position of organic equilibrium," and lead to the origin of a new "form" in various degrees removed from the original type.

(2) Prof. Jaekel endeavours to draw a sharper distinction than has hitherto been made out between the origin of a species and the emergence of a new structural "form." The origin of a species is a consequence of some form of reproductive isolation (Kreuzungsausgleich)—of a restriction in inter-crossing, of an alteration in the radius in mutual fertility; but the structural differentiation which leads up to a new "form" is a very different, and it may be much more important matter.

(3) The third, and perhaps the most essentially new contribution which Jaekel makes to the interpretation of structural transformations, is that he does not regard these changes as arising by the summation of the qualities of adult forms, but as due to inhibitions or accelerations of development in the juvenile plastic stages. Each individual ontogeny is a re-creation of the inherited "Stammform," with a plastic period in which new adjustments may arise.

While we have indicated the three most conspicuous ideas in this essay, we have done it scant justice. It expresses the views of an expert palæontologist in regard to the mechanism of evolution, and is full of originality and suggestiveness. The illustrations in evidence are chiefly drawn from crinoids, brachiopods, and trilobites. We venture to express the hope that the author will expand his essay into a book, in which he may condescend to be a little less terse.

J. A. T.

Ausgewählte Methoden der analytischen Chemie. By Prof. Dr. A. Classen and H. Cloeren. Pp. xvi+831. (Brunswick: Vieweg und Sohn, 1903.) Price 20 marks.

THIS is just the kind of book to which an analyst will turn with pleasure. It is well bound, well printed, and really beautifully illustrated. It contains, moreover, a good account of recent methods or improvements in old ones, with the necessary details and manipulative *Kunstgriffe* which in analysis often means the difference between failure and success.

The subjects which are included in the volume are the estimation of the common gases, water analysis, which is fully treated, the analysis of hydrogen peroxide, ozone, explosives, the common compounds of carbon, sulphur, phosphorus, boron and silicon, the cyanides, concluding with a chapter on organic analysis.

It would seem ungenerous to try to discover omissions or to offer criticisms when the authors have given so much, and with such evident care and thoroughness. But the book has one weak point which is common to many books of this class. The authors have not submitted all the methods they describe to personal revision (indeed, it would be difficult to do so without the expenditure of a good deal of labour), but there is no doubt that such a critical examination, which would help the reader to a choice of his method, would greatly add to the value of the volume.

However, the important point for the analyst is that he has in his possession the most recent information from a variety of sources which has been collected and sifted by a discriminating authority on analytical matters.

In looking through the volume it is evident that the analytical work of recent years has lain rather in the perfecting of existing methods than in the discovery of new ones. This seems only natural; for although new technical processes are constantly coming into operation, the number of new reagents does not increase *pari passu*, and it follows, therefore, that the demands made upon rapidity and accuracy in technical analysis have to be met by the skilful adaptation of old processes to new needs.

An interesting illustration of this is Emmerton's new method for estimating phosphorus in iron, described in the appendix to this volume. Phosphorus has always been precipitated as phosphomolybdic acid, and the precipitate either measured or weighed. The drying of a precipitate always means a loss of time. By the new method the precipitate is not dried, but reduced with zinc and sulphuric acid, and the lower oxide of molybdenum which is formed is titrated and estimated with permanganate. J. B. C

O'Gorman's Motor Pocket Book. By Mervyn O'Gorman. Pp. ix+287. (Westminster: Archibald Constable and Co., Ltd., 1904.) Price 7*s.* 6*d.* net.

IT is not surprising to find that at last a "motor" pocket book has appeared; in fact, it is a wonder such a work has not appeared sooner. Engineers have long had their "Molesworth," and now the motorist can lay claim to his "O'Gorman" when in trouble or in doubt.

This interesting and instructive book is alphabetically arranged, thus rendering easy the finding of any par-

ticular item of information required. Our author has a breezy style of expression which adds largely to the pleasure of reading the book. Take, for instance, his treatment of that all-important worry of the motorist, the "police." Mr. O'Gorman says, "to pass unchallenged at a speed in excess of the legal limit—a thing which is daily accomplished by carts, hansoms, and even by the London omnibuses on almost every run when the gradients favour them—and by almost every other vehicle everywhere—remember that by sitting upright with a calm face (on a quiet car) you produce no impression of speed except on turning a corner. If you turn a corner without being able to see down the road you are entering at over 20 miles per hour you deserve to be punished. If, however, you stoop forward (this gives the impression that you are withstanding and endeavouring to avoid a high wind pressure), jamb your hat over your eyes, screw up your face, stare intently and anxiously, do a great deal of steering with visible swinging of your body, blow your horn in such a manner as to say 'Get out of my way' frequently, instead of pressing it slowly and peaceably, you will invariably be arrested. I think a couple of good actors could safely wager to be stopped by an otherwise inoffensive constable at a pace of 10 miles per hour, especially if mounted on a machine the teeth of whose gear 'gave tongue' like a siren, after the manner of certain makes, they would as surely be fined."

The above description is quaint but true, as every motorist knows. On the other hand we find admirable descriptions and explanations of the all-important details of car management, design, &c. Our author's treatment of electric ignition is excellent, the accompanying diagrams being particularly clear. On the subject of accumulators we find much useful information, and, generally, the work contains those hundred and one wrinkles the knowledge of which goes to constitute the successful and trustworthy driver of a motor car, and we cordially recommend to all such the possession and careful perusal of this pocket-book.

N. J. L.

Weather Folk-Lore and Local Weather Signs. Prepared under the direction of Willis L. Moore, Chief U.S. Weather Bureau, by Edward B. Garriott. Pp. 153. (Washington, U.S.A.: Government Printing Office, 1903.) Price 35 cents.

THIS volume is divided practically into two parts, the first dealing solely with weather folk-lore gathered from many available sources, the second with summaries of local weather signs as based on special reports of observers to the chief of the U.S. Weather Bureau. The latter are arranged alphabetically as regards the names of the towns from which these reports are received, and deal for the most part with the prospect of fair or foul weather as indicated by the appearance of clouds, direction of wind, movements of barometer, &c. In fact, weather-folk-lore, as such, is naturally conspicuous by its absence. This portion of the work will not be of much interest to Britishers, as the signs only hold good for the particular parts of the country in question. The first portion, on the other hand, is of more general interest, as many of the quaint sayings were, so far as can be judged, the results of observation of long experience. The subject is subdivided under several different titles, according as the weather was foreshadowed by wind, barometer, clouds, humidity, temperature, &c., or by the peculiar effects of these on objects animate or inanimate. Many curious sayings, probably unfamiliar to British readers, are here collected, but one, with regard to the effects of atmospheric moisture that precedes rain, is rather gruesome. "When the locks turn damp in the scalp house surely it will rain" (American Indians).

Reference is also made to the moon as a weather prophet, to many weather proverbs of a miscellaneous kind, and to recent work on possible long-range weather forecasting.

The book concludes with a series of charts which illustrate the local weather signs as observed at regular stations of the Weather Bureau.

W. J. S. L.

The Principles of Mechanism. By Herbert A. Garratt. Pp. viii+166. (London: Edward Arnold.) Price 3s. 6d.

IN this book the author has brought together his notes of lectures delivered in connection with a course of instruction in mechanism at the Northern Polytechnic Institute, Holloway. The work is divided into two parts, dealing respectively with the kinematics and the dynamics of machines.

These notes are no doubt valuable to the compiler and useful to the students under his charge, but they seem too fragmentary to be of much service to the general reader. The descriptions of the various mechanisms are concise and to the point, but the mathematical treatment, where given, is often unsatisfactory. Moreover, there is sometimes a want of perception of the relative importance in the several items which have been introduced. Thus in the second chapter, dealing with circular and straight line motion, the fundamental subject of simple harmonic motion is not properly defined, and is dismissed with a meagre treatment extending only over one page, whilst nearly three pages are devoted to the comparatively unimportant problem of finding the crank position which corresponds with the maximum piston velocity in a steam engine, answers being given in degrees, minutes and seconds. Special constructions for velocities and accelerations such as Mohr's and Klein's are given, but these are not well explained, and the reasoning is difficult to follow; the author seems to be unaware of the fact that he is here dealing with vector quantities.

In chapter iii. the treatment of wheel teeth seems unsound. The chapter is somewhat redeemed by descriptions of gearing chains for cycles, and modern machines for cutting worm wheel teeth and bevel wheel teeth. A number of valve gears are described in chapter iv., with some applications of the Zeuner valve diagram.

Part ii. opens inauspiciously, for in the first chapter, which enunciates the general principles that are to guide the student, power and work are confused with one another, and an equation of energy is written down which involves the addition of power and kinetic energy as if they were quantities of like kind. This part includes a casual treatment of speed regulation as affected by fly wheels and governors, one or two problems on balancing, water motors, and friction. Two useful examples of axial flow turbines, with numerical data and good diagrams, are given, the information being supplied to the author by Messrs. Günther and Sons, of Oldham.

Calculating Scale, a Substitute for the Slide Rule. By W. Knowles, B.A., B.Sc. Pp. 29. (London: E. and F. N. Spon. Ltd.; New York: Spon and Chamberlain, 1903.) Price 1s. net.

IN this book the author provides and explains the use of two graduated scales, placed adjacent to each other for comparison and fixed together, on one of which numbers can be read off, and on the other the logarithms of the numbers, or *vice versâ*. This compound scale is 100 inches long, and is cut up into

twenty lengths, printed in successive columns, and occupies four pages of the book. This comparatively great length enables three significant figures to be read off directly from the scale divisions and subdivisions, while a fourth figure can be estimated. The author claims that computations can be made with a degree of accuracy equal to that obtained by the use of four-figure log tables, and with less trouble. We suspect, however, that few would be found who would allow this claim, or be willing to give up their tables for the author's plan. The title of the book is somewhat misleading; instead of a "substitute for the slide rule," the proper description would be, a substitute for tables of logarithms; the "calculating scale" is only an equivalent for the slide rule in the sense that a log table may be so regarded. We fail to see any useful purpose that this scale is likely to serve.

Practical Orthochromatic Photography. Photography Bookshelf, No. 14. By Arthur Payne, F.C.S. Pp. 178. (London: Iliffe and Sons, Ltd., 1903.) Price 1s. net.

IN these pages the author gives us an excellent account of the fundamental principles governing this branch of photography. Although he does not pretend to exhaust the subject, yet the reader will find that enough of the theory has been dealt with to enable him to obtain a good ground-work of the scientific principles for his own practical use. The ten chapters into which the book is divided treat of the advantages of this kind of photography, light, the use of the spectroscope, visual and photographic brightness, light filters, their use and effects, and other important subheads.

Not only is the letterpress clear, but the numerous illustrations are well chosen, and add to the utility of the volume. Those about to take up this branch of photography, and others who are practising it, should find this book a good guide.

Tombs of the Third Egyptian Dynasty at Reqâqnah and Bêt Khallâf. Report of Excavations at Reqâqnah, 1901–2. By John Garstang, B.A., B.Litt. Pp. 70+xxxiii plates. (Westminster: Archibald Constable and Co., Ltd., 1904.) Price 21s. net.

AFTER an introductory chapter describing the site of the excavations and the nature of the results, Mr. Garstang deals with the continuity of early history and the place of the third Egyptian dynasty in ancient history. Three chapters are then devoted to stairway tombs, to their construction, special features, and objects from them, respectively. The evolution of stairway tombs is discussed in a later chapter. Other sections of the volume are devoted to the necropolis, burial customs, burials under pottery vessels, objects from the smaller tombs, and the archæology of the third dynasty. There are thirty-three full-page plates containing a large number of good illustrations.

Worked Problems in Higher Arithmetic. By W. P. Workman, M.A., B.Sc., and R. H. Chope, B.A. Pp. vii+144. (London: W. B. Clive, 1904.) Price 2s.

THIS useful little book consists of two sections; in the first many of the difficult problems in the author's "Tutorial Arithmetic" are fully solved, while the second part, which will appeal more to teachers, comprises solutions of all the problems of Section xi. of the same work. The book should prove of value to the private student particularly, who is, we notice, warned that "but little benefit will accrue to him unless he makes it a regular practice to attempt to solve the questions for himself before reading the solutions here given."

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Blondlot's *n*-Rays.

FOR the past few months I have endeavoured to repeat some of Blondlot's measurements with *n*-rays, taking every precaution and following out closely the methods and adjustments described by Blondlot in his numerous papers which have appeared during the past year in the *Comptes rendus* of the Paris Academy of Sciences.

A Nernst lamp consuming 176 watts was used, which is described by Blondlot as emitting the rays most copiously. A variety of screens of phosphorescent calcium sulphide, some brilliantly phosphorescent, others very feebly so, were employed for the detection of the rays. The experiments were carried out in an absolutely dark room to which the eye had become accustomed by a wait of fifteen or twenty minutes, the only light visible being the phosphorescent glow of the screen. Lead screens, thickness $\frac{1}{4}$ inch and 1/16 inch, were used to intercept the rays, and occasionally a quartz lens was used to focus them on the screen.

But in no case could any certain difference in the brilliancy of the screen be shown to be due to the presence of the *n*-rays, although the experiments were repeated many times and under varied conditions. The only observed differences in brightness could be assigned to four known causes. If initially the sulphide was fairly bright, after a while it appeared less so, owing to the natural decay of the phosphorescence. If the phosphorescence was very feeble it appeared more brilliant by indirect than by direct vision, this being a well known phenomenon in physiological optics, which has been admirably discussed in the paper by O. Lummer, of which a translation appeared in NATURE of February 18 (p. 378).

The third effect was the increase of brightness due to the increasing sensitiveness of the eye during the first few minutes spent in a dark room, and the fourth is mentioned below. Several competent observers in England and Germany have likewise obtained negative results in looking for what Blondlot describes as being so simple, and it seems advisable to direct attention in the columns of NATURE to certain experimental precautions not sufficiently observed, perhaps, by Blondlot in the course of his work.

A slight rise in temperature increases the brilliancy of the screen. Using a screen which showed no appreciable brightening under the influence of the *n*-rays from a Nernst lamp, it was found that by heating it gently, perhaps 10 or 15 degrees centigrade, without using *n*-rays at all, the brightness increases very perceptibly, possibly 50 or 100 per cent. as nearly as could be estimated by simple observation; so that efforts to detect *n*-rays may be partially vitiated by the presence of heat effects, from the body of the observer, &c., unless special precautions are taken to show that this is negligible. Mr. S. G. Brown has brought this point forward very clearly in a recent letter to NATURE (January 28).

On reading a recent striking paper by Blondlot on the index of refraction and wave-length of *n*-rays (*Comptes rendus*, January 18), one cannot, considering the experimental conditions, fail to be impressed by the extraordinary experimental skill required to carry out what Blondlot describes.

In measuring the index of refraction, a comparatively wide slit (5 mm.) was used, placed 14 cm. from the filament of a Nernst lamp. After traversing the slit, the rays passed through an aluminium prism, and were dispersed, each homogeneous pencil spreading out into a constantly broadening beam. Now in measuring the angles of deviation there would be two difficulties to be overcome. The beams become so broad, being 1 cm. wide at a distance of 14 cm. from the slit, that the intensity is greatly weakened. Furthermore, it may be shown, by using Blondlot's actual values for the indices of refraction, and calculating backwards, so as to get the angles of deviation, by the well known formula for Descartes's method, that among the total number there are at least three consecutive beams

the deviations of which differ by only 1·5 or 2·2 degrees, and by making an accurate geometrical diagram it will be seen that these beams never entirely separate out from each other, but continue to overlap no matter how far one passes away from the prism. Thus under the conditions of the experiment it would hardly be possible to detect the existence of separate beams at all. Blondlot does not mention the use of a lens to focus the rays, and if one were used it would be necessary to re-focus it separately for each beam, according to the different values of the indices of refraction.

In measuring wave-lengths of light by a diffraction grating, everyone knows how enormously the intensity of the incident light is reduced in the different diffracted images, yet Blondlot was able, apparently with the greatest ease, to split up a divergent pencil of *n*-rays, coming through a slit 5 mm. wide, into eight divergent homogeneous beams by passing it through a prism, then to take only as much of one single beam as would pass through a second slit 1·5 mm. wide, having perhaps 1/50 the intensity of the original beam, and after allowing this small fraction of the whole radiation to fall on a grating, to detect the existence of, and measure up accurately, a central image and no less than twenty diffracted images, the intensity of each of which must have been considerably less than 1/1000 of the original beam. All this was done with a radiation so feeble that no observer outside of France has been able to detect it at all.

But it is questionable from another point of view whether the different diffracted images could be observed at all, at least in certain cases, under the conditions of the experiment, for the slit was quite broad, 1·5 mm., and apparently no lens at all was used to bring the spectra to a focus. The central beam and the various diffracted beams would thus continue to broaden out and become more and more diffuse. Now using the ordinary formula for a plane grating and calculating back from one of Blondlot's wave-lengths, $0·0081\mu$, it follows that for radiation of this wave-length the distance apart of adjacent spectral images at a distance, say, of 50 cm. from the grating would be only 0·8 mm., or considerably less than half the breadth of the central beam itself. This is with the grating mentioned as having 200 lines to the millimetre. With the grating containing 50 lines to the millimetre, the distance between adjacent spectral images would be only 0·2 mm., or less than 1/8 the width of the central beam. In other words, there would be no definition, and the broad central band, together with the broad diffracted bands, would hardly separate out at all, even using as large an angle of incidence as 75 degrees.

In measuring wave-lengths by means of Newton's rings, it is well known that the rings produced by a fairly bright source of light, such as a sodium flame, are quite faint, and a dark background is necessary in order to see them at all. Yet if we accept one of Blondlot's wave-lengths, $0·0085\mu$, as correct, he must have succeeded in counting up no less than 70 *n*-ray rings in the space between two adjacent sodium rings, and this by the use of a source of radiation only 1/8 the intensity of the original source, as the latter must have been split up into homogeneous beams before the rings were formed. It would be interesting to know just where the phosphorescent screen was placed in this experiment, as the rings are formed in the thin air gap between the lenses, and the eye must be focused on that point to see them sharply. But of course, the screen could not be put between the lenses, as the latter could not then be brought into close contact, and if it were placed anywhere else the rings would be somewhat blurred.

C. C. SCHENCK.

McGill University, March 10.

Escape of Gases from Atmospheres.

IN a recent number of NATURE (January 14) there appears an article on the above subject by Dr. G. Johnstone Stoney, in which he corrects a statement in the literary supplement of the *Times* of December 25, 1903, in regard to the escape of helium from the earth's atmosphere. The permanence of planetary atmosphere is of so much importance to science that I trust I may be permitted through your columns to add a word to what Dr. Stoney stated in his letter of January 14.

The problem of the escape of gases from planetary atmospheres has, as Dr. Stoney remarked, been approached by two distinct methods :—

(1) The inductive method, by taking the conditions as they appear in nature and arguing upward to results concerning our atmosphere which may then be applied to other planetary atmospheres.

(2) The deductive method, by using the laws which are acknowledged to appertain to gases under known conditions, and by assuming conditions under which these laws are known to apply for the outer stratum of our atmosphere, and to apply these laws to the escape of molecules from the atmosphere.

The first of these methods was made use of by Dr. Stoney in his memoir on "Atmosphere upon Planets and Satellites" in the *Astrophysical Journal*, 1898. In this paper Dr. Stoney argues that since helium is coming into the atmosphere at a greater rate than it is being removed from the atmosphere by natural carriers, and since it has not been proved to be increasing as a constituent of the atmosphere, it must be escaping from the outer stratum of the atmosphere, and in doing so must attain a speed of 9·27 times its mean velocity at a temperature of $-66°$ C.—the velocity that would carry it beyond the earth's attraction.

In the *Astrophysical Journal*, January, 1900, I have shown by the Maxwell-Boltzmann distribution of velocity that if we assume the outer stratum of the atmosphere to be at a temperature of 5° C. with a density equal to that at the earth's surface, and to be composed entirely of helium, only $10·34 \times 10^{-4}$ c.c. of helium would be favourably situated, and would attain a velocity sufficient to escape in 10^7 years—the computed age of the earth; and also that if we assume a temperature of 66° C., the number of c.c. that would attain to that velocity would be $22·10 \times 10^{-24}$, or less than a single molecule in the same length of time; while if we assume a temperature of $-180°$ C., which I believe to be much more probable for the temperature of the ultimate stratum, only $91·6 \times 10^{-86}$ c.c. will escape, which, of course, means that an atmosphere of helium at normal pressure and at the average yearly temperature could not escape from the earth.

If these results, deduced from the kinetic theory under conditions to which it is generally acknowledged that the kinetic theory does apply, have any value whatever, it seems to me that they completely refute the assumption made by Dr. Stoney that helium is escaping from our atmosphere. But these results do not stand alone as evidence of the permanency of our atmosphere. Prof. Bryan by an entirely different method (see *Transactions* of the Royal Society, London, 1901) reaches the same conclusion, both in regard to hydrogen and helium.

In the *Monthly Weather Review* for August, 1902, I further discussed the probability of molecules, in a highly attenuated atmosphere, reaching velocities much greater than under normal conditions, and it is there shown that no conceivable effect could influence the results sufficiently to allow the escape of helium from the atmosphere. In further evidence of the fact that the latter view has been accepted by other writers, I may cite the work of M. E. Rogovsky (see *Astrophysical Journal*, November, 1901), who, after having published the above article, published a note in NATURE (July 3, 1902) in which he stated that his results would have to be modified in accordance with the results obtained for the escape of gases according to the kinetic theory.

In conclusion, permit me to say that although I fully recognise the imperfection of the kinetic theory in dealing with problems of attenuated atmospheres, yet I believe that the results arrived at under the special assumptions made will have to stand until it can be shown by other *a priori* reasoning that these conclusions are not within the limits of the probable results, *i.e.* that the escape of helium from our atmosphere is practically *nil*.

S. R. COOK.

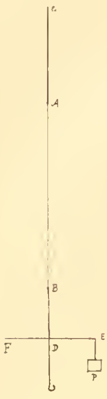
Case School of Applied Science, Cleveland, O., February 22.

Demonstration of Magnetostriction by Means of Capillary Ripples.

IN his experiments on the change of length by magnetisation, Joule ("Papers," vol. i. p. 50) mentions that "the expansion, though very minute, is indeed so very rapid that it may be felt by the touch." If everybody were endowed

with such an acute sense of touch as to discriminate an elongation of a micron, it would be superfluous to think out any arrangement which would serve to demonstrate the minute change of length due to magnetisation. Since the elongation generally amounts to a few millionths of the total length of the magnetised wire, it is necessary to have an intricate apparatus in order to show that the ferromagnetic wire changes its length by magnetisation. The demonstration of magnetostriction to a large audience is thus a matter of no small difficulty.

After trying in vain several means of showing the magnetic change of length and the Wiedemann effect in a class-room, I finally succeeded in demonstrating them by using the capillary ripples formed on the surface of mercury. A ferromagnetic wire AB is soldered at both ends to brass or copper wires AC and BD. D is bent into a hook, so that the wire can be properly loaded by hanging weights from it. Another wire DE is soldered at right angles to BD and bent downwards. The extremity of the wire carries a small plate P, and dips at the centre of a circular or rectangular mercury trough. AB is hung vertically in the axis of a magnetising coil, which should be much longer than the wire AB. By passing an alternate or intermittent current of known frequency fine capillary ripples are formed, which can be easily projected on the ceiling by placing a glass plate, inclined at 45° to the vertical, over the trough, and illuminating the trough by passing the sunbeam or electric light horizontally on the glass plate. By adjusting the weights, it can be easily demonstrated that for a current of given frequency the elongation or contraction generally reaches a maximum. It may be doubted if the maximum is not due to the coincidence of the frequency with that due to the period of the elastic vibration of the wire; repeated experiments show that this is by no means the case.



Next place the magnetising coil horizontally, and stretch the wire horizontally by attaching to D a flexible string, which is slid over a pulley and pulled by the weights. The portion of the wire EP is bent downwards, and P dipped in a mercury trough. The other end, F, of the wire ED is dipped in a mercury pool, and an intermittent or alternate current of known frequency passed through the wire FDBAC. On magnetising the wire longitudinally by a steady current, fine capillary ripples are seen in the trough, which can be projected as before mentioned.

As both effects are greater in nickel than in iron, better results are obtained with the former wire.

H. NAGAOKA.

Physical Laboratory, Imperial University, Tokyo, February 2.

Earth Structure.

FROM Mr. Charles J. J. Fox's letter in NATURE of March 10 it is not wonderful to learn that Prof. Milne emphasises the demand for some theory which shall explain pulsatory movements by which large tracts have been alternately raised and lowered. Prof. Milne has seen too much of seismic phenomena not to do so. But with our limited knowledge of the earth's interior, it is still a matter of pure conjecture in what order the globe solidified from being a mass of heated vapours, and quite open to suppose that after the heaviest took the lowest place, a hollow was formed, and the crust became a cooling shell, with a layer of radium—about the heaviest of metals—underneath to remain a perpetual generator of subterranean heat. This state of things may be taken as the starting point; for it was not until the crust hardened into shape that the problem for which Prof. Milne demands some effort at a solution came into existence, and it is curiously enough propounded by the picture which happens to be on the opposite page of NATURE "overfolding in Upper Carboniferous limestone"—to account for which there are geologists who would require oscillations between land and sea continued for an indefinable length of time.

It is easy to make a model range of strata in plastic clays and apply lateral pressure crunching them into similar foldings, while to stand before the real rock and coldly reason out what actually happened is another matter. Indeed, the present writer could make nothing that was not self-contradictory out of such contorted strata, especially when exposed on a very large scale, as occurs near Singapore, for instance, until on visiting one of the large (and active) craters in Java, a mile in diameter and with vertical faces 1000 feet high, the whole mystery at once became clear. For it was evident that a volcano (including fissures in the term) can erupt strata of every kind of material, red sandstone, conglomerates and shales, simulating those of aqueous deposition, and in all sorts of thicknesses from many feet to a few inches, the material being propelled for thousands of feet into the air, and perhaps all in the course of a few days of activity. Vesuvius, Etna, and even Hawaii can show nothing resembling the astounding volcanic formations in Java.

The most capricious vertical and lateral movements are to be associated with volcanic action, but in the main it is successive deposition on uneven ground that manifestly causes the curvings which are to be so often noticed in exposed sections, and are typically delineated in the picture on p. 439. Adoption of this theory, drawn from what is to be seen round Java craters on a scale nowhere else matched, does no doubt introduce some modern views into established geology, particularly in the element of time and as to the origin of much of our coal.

It is, however, widely allowed that there was a phase of great terrestrial instability just before the appearance of mammals, and equally certain that the vast ejections of successive periods varied in composition so as to give their special mineral character to the Silurian, Devonian, Carboniferous and later formations as classified by geologists. We can form only the faintest picture of the agitations on the surface of the globe in those days; of the tranquil intervals during which palms and forests grew, roamed in by animals, while shells were cast up on innumerable beaches; and then of their sudden submergence under beds of volcanic ejections following in rapid succession, and reducing all life to fossils. Now that the earth has quieted down, the process is only faintly indicated by what has occurred in historic times, as, for instance, in the consternation produced among the residents by the ejection of only a single covering of volcanic mud over many square miles of country at the eruption of Tarawera, in New Zealand, which the writer saw as a grey unctuous mass, evenly coating the surface of the landscape 18 inches thick six weeks after the eruption. Admission of the volcanic hypothesis, though it does not explain pulsatory movements on a continental area as yet, enables the origin of contorted strata met with so frequently in the British Islands and abroad to be recognised at a glance, as well as that of whole series of the stratified rocks.

A. T. F.

London, March 15.

Spawning of the Plaice.

IN continuation of the letter you published last week (March 17), I can now supply some information as to spawning in the open sea.

Mr. Andrew Scott, resident naturalist at the Piel (Lancashire) hatchery, who is now examining all our tow-nettings taken in the Irish Sea, reports to me that the first plaice eggs this year appear in a gathering taken by our fisheries steamer on February 2 at $1\frac{1}{2}$ miles south-west by south of Patches buoy, off Aberystwyth; that the next occurrence was on February 10, 6 miles west of Morecambe Bay lightship; and then again on February 18 at 6 miles north-west of the Liverpool north-west lightship. Plaice eggs have been present in every gathering since that date off both the Welsh and the Lancashire coasts. The Port Erin tow-nettings later than January have not yet been examined in detail.

It is evident, then, that the plaice in the Irish Sea started spawning about a month earlier than those in our two hatcheries. It would be interesting to have the dates for the North Sea and the English Channel.

W. A. HERDMAN.

Liverpool, March 22.

In a letter in NATURE of March 17 Prof. Herdman mentions that "the plaice in the open-air ponds at the Port Erin Biological Station started spawning on March 3, and those at the Piel (Lancashire) Sea Fish Hatchery (under cover) on March 1." He would like to know how this record compares with that of fish in the sea. As the professor suggests that "probably the officials of the International Investigation will be able to speak as to the condition in the North Sea and . . . English Channel," I herewith state my experience.

About the middle of February I was informed by fishermen that plaice in the North Sea (southern part) were for the most part spent. From personal observation I can state that the larger plaice trawled by the s.s. *Huxley* in the Great West Bay on February 26 were spent. Further, the eggs procured in the tow-nets at the various hydrographic stations in the English Channel in the latter part of February can hardly fail to prove, on examination, to be those of plaice. Prof. Herdman is probably aware that investigations conducted by the Marine Biological Association in the south Devon bays during 1901 and 1902 established the conclusion that "the maximum spawning period lies between the third week of January and the second week of February."

In regard to the North Sea, I may mention that I examined on board about 300 plaice trawled by the s.s. *Huxley* on March 11 and 12 on the south-west part of the Dogger Bank, and that of these fish the larger were spent, the smaller immature. Only one female had a considerable remnant of ripe eggs in its ovary, but none of the males were "running." The eggs procured in the tow-nets in the southern part of the North Sea are apparently of several species, but plaice are almost certainly present, and probably predominate. From present facts and previous records I conclude that, as compared with the North Sea and English Channel, Prof. Herdman's plaice are late in *starting* to spawn. WM. WALLACE.

Marine Laboratory, Lowestoft, March 20.

Euclid's Definition of a Straight Line.

On p. 409 your reviewer states that "Euclid says nothing about the extreme points of the line" in his definition of a straight line, but regards "*all* the points on it."

Will he kindly look at p. 410 of your vol. lvii., where I have given reason for considering the older translation of Euclid's words to be correct. R. E. B.

I HAVE read the passage referred to, but for many reasons cannot admit that the argument is conclusive. In the first place, the quotation from Aristotle's "Ethics" has no authority whatever; it has no grammatical connection with the previous context, and shows every mark of being a marginal annotation which has been wrongly incorporated with the text. Then the use of the same symbol for different points (AA, BB, ΓΓ denoting segments) is very unusual, and is not what we should expect from a competent mathematician, so it is rash to infer that the use of ἐφ' ὧν ΓΔ in the sense "of which Γ, Δ are the extremities" was a current technical practice at the time of the writer. But even if this be admitted, it does not follow that Euclid means the same thing in his definition of a straight line; all the evidence, it seems to me, points in another direction. Euclid has just defined points, and stated that the extremities of lines are points; if he had intended what the current English translation makes him say, would he not have written, "A straight line is a line which lies evenly (ἐξ ἴσου) with respect to its extremities"? Again, in i. 9 he says, "on AB let any point D be taken" (εἰλήφθω ἐπὶ τῆς AB τυχὸν σημεῖον τὸ Δ); now if D is taken "on" AB, surely it is included in "the points on AB" (τὰ ἐπὶ τῆς AB σημεῖα). Moreover, Euclid explicitly recognises infinite, or indefinitely long, straight lines; the enunciation of i. 12 is Ἐπὶ τὴν δοθεῖσαν εὐθεῖαν ἄπειρον, &c.; see also the scholia in Heiberg's edition of the "Elements," v. 78–83, 136–9.

The real difficulty, I think, is in the interpretation of ἐξ ἴσου; what this is intended to mean can hardly be settled, unless new documents should be discovered. Personally, I believe that what Euclid had in his mind was something of this sort:—if we stand at any point A on a straight line and look towards any other point B on it, the appearance of AB is always the same, and the same as that which we get by going to B and looking towards A. But this is only a conjecture; my principal contention is that τὰ ἐπὶ γραμμῆς τινὸς σημεῖα naturally means "the points on a line," namely, all the points on it, including its extremity or extremities if it does not extend indefinitely both ways, and that this is the sense which the phrase bears in Euclid's definition of a straight line. YOUR REVIEWER.

Respiration in Frogs.

THE respiratory movements of frogs have been studied by several observers, especially Gaupp and Baglioni, of recent years. These zoologists have pointed out that the rapid up and down movement of the floor of the mouth, so typical of most batrachians, is a kind of aspiration, and does not force air in or out of the lungs to any great extent.

In a frog recently under observation I noticed these movements taking place while the creature was entirely submerged, and not engaged in croaking. I should be glad to learn whether this is an occurrence well known to your readers. To the best of my knowledge neither of the abovementioned naturalists allude to it, but I have not here access to their original papers (Gaupp, *Archiv. für Anat. und Physiol.*, Anat. Abtheil, 1896; Baglioni, *ibid.*, Physiol. Abtheil, 1900).

Is it not possible that in certain circumstances, supposing the nostrils to be open and the glottis closed, even the adult frog may take in water into its mouth for the purpose of breathing? The remarkable condition of the blood capillaries in the mouth points to it as being normally a place for interchange of gases when air is admitted. If this suggestion be possible, the power possessed by frogs of undergoing prolonged immersion may be partially explained. M. D. HILL.

Zoological Laboratory, Eton College, Windsor, March 20.

Subjective Colours.

IN the discussion on this subject in NATURE I have not seen any mention of a phenomenon which I have now and then noticed of late years, but never before, nor have I seen it described anywhere. When I have been reading and have become sleepy, just as I was about to fall asleep portions of the print in patches in different parts of the page turned a brilliant red. It is impossible to make any exact observations on the subject, because the moment one rouses oneself to do that the printing resumes its ordinary black. I do not find that this phenomenon is affected by the amount of light in any way.

The phenomenon mentioned by Mr. E. Hubbard (p. 318) is true in my case, and I attribute it to the fact that the eye that is exposed to the greatest light is more or less dazzled, or else has light reflected into it from the eyelids, and so the field of view is suffused with red or orange light which combines with the tint seen with the shaded eye. T. W. BACKHOUSE.

West Hendon House, Sunderland, March 18.

Secondary Radiations of Radium.

I ENCLOSE two prints I have taken with a radium screen. No. 1 shows the impression of a steel pen-nib, a steel screw, and an ordinary paper fastener. These articles were laid on a photographic plate and exposed for 6 days. No. 2 shows the impression of two bronze coins (halfpennies) similarly placed, but exposed for $13\frac{1}{2}$ days. One coin rests partly on the other, and at this part the edge of the lower coin is very much blurred, pointing to rather great secondary radiation from the upper coin.

Another peculiarity seems to be that while in one of the photographs the articles are shown as shadows, in the other the coins show bright on a darker background. Does this point to the possibility of bronze exposed to radium rays for such a period as $13\frac{1}{2}$ days becoming more radio-active than radium itself? J. S. DAVIS.

Culham College, Abingdon, Berks, March 19.

BRITISH LIZARDS.[1]

WE are glad to welcome this companion volume to the author's excellent work on British snakes, for with the two together the amateur naturalist will learn practically all that he wants to know with regard to the reptiles of our islands. Not that these works are by any means exclusively for amateur naturalists, as there is much matter in both which cannot fail to interest their professional brethren. If Dr. Leighton can be induced to treat the amphibians in a similar manner, we shall have a complete account of the life-history of all the British terrestrial cold-blooded vertebrates.

The author's mode of procedure is very thorough. After giving the leading characteristics of lizards in general, he describes in some detail their anatomy, and then proceeds to deal, *seriatim*, with the five British representatives of the group. The external features of each are illustrated by reproductions from photographs, of the excellence of which our readers have an opportunity of judging for themselves from the accompanying specimen.

Photograph by Douglas English, Dartford.

FIG. 1.—Female of the Common Viviparous Lizard. (From Leighton's "Life-History of British Lizards.")

It is a common belief that reptiles are totally wanting in Ireland; this, however, Dr. Leighton shows to be an error, as the common viviparous lizard occurs in that island, where, however, it is the sole representative of its order. How it got there, to the exclusion of its brethren, he attempts to show. In the later chapters of the book the author has gone very carefully into the local distribution of lizards in our islands, with results of considerable interest; and in order that readers may record new observations for themselves a few tabulated blank pages are appended. Horticulturists should pay special attention to the author's statements as to the great value of the slow-worm as a slug-exterminator. The enlarged diagrams of the "squamation" of the head afford an easy and exact method of identifying the British species of lizards.

Special interest attaches to Dr. Leighton's investigations with regard to the phenomenon of tail-fracture in lizards. It is pointed out that such lines of fracture occur at regular intervals of two scales' length, such spaces coinciding with the lengths of the caudal muscle; and the author is of opinion that the superficial structures have much more to do with determining the fracture than have the septa in the caudal vertebræ.

Concise, exact, and at the same time interesting is our verdict with regard to this admirable little volume.

R. L.

[1] "The Life-History of British Lizards, and their Local Distribution in the British Islands." By G. R. Leighton. Pp. xiv+214; plates. (Edinburgh: G. A. Morton, 1903.) Price 5s. net.

THE EDUCATION OF JAPANESE NAVAL OFFICERS.

ON reference to the second article on "Science in the Navy," published in NATURE of last year, it will be found that the gist of that article was the condemnation of the over-specialisation of officers, accompanied by remarks in favour of the interchangeability of their duties, the practice of the German Navy being brought forward as an existing evidence in support of such views.

Increased support of these views will be found in a valuable lecture which was recently delivered by Lieut.-Commander K. Sato, of the Imperial Japanese Navy, at the Royal United Service Institution, on "The Education of Japanese Naval Officers of the Executive Branch," in which that officer shows that the "Eastern nation," thought at one time to be "too bookish," is by its methods of education making its naval officers eminently practical men with a good grounding of general and scientific knowledge.

The lecturer admitted that his country had fairly followed Great Britain's footsteps in this important matter of education, and had duly profited by the instruction of her officers, but modestly hinted that perhaps in one or two small particulars they had gone "one better" than we had. Here it is encouraging to note that the gallant chairman, with his life-long education in the traditions of our long established Navy, said that there were many things this country could learn from the Japanese Navy—encouraging because we believe that this power to see good in others where it really exists and determination to profit by the same is a ruling spirit amongst our officers.

Whilst giving due encouragement to the specialist officer, it is the constant effort of the Japanese to produce *all round officers* which is so striking, and one would think they had adopted the following as their maxim:—"Inadvertence is no excuse for the non-performance of any duty, for, it is the duty of an officer to make himself acquainted with the detail of every duty he may be called upon to perform."

This is a high standard, and not many fully attain thereto, but it will hardly be denied that it should be the aim of every officer, whilst those who regulate education should do all in their power to keep the road open with efficient aids by the way. Interchangeability is a very promising road to such a goal.

Another point which this lecture brings out clearly

is the training of the specialist officer in the Japanese Navy. He is encouraged to specialise according to the bent of his mind, whether in gunnery, torpedo or navigation, but apart from the special course in those subjects which he has to go through, each officer has to take up several other subjects not immediately bearing upon the one in which he is to be strongest. Here again are points to be studied and thought over, for it is certain that until very recently our specialist officers have been kept too much in a groove. The gunner has "stuck to his linstock," the "timonnier to his helm," and though either might easily be called to do the other's duty, they have seldom if ever changed duties and thus obtained experience.

As rewards to specialist officers, the Japanese give the more important positions and earlier promotion, but no extra pay. We give extra pay but no earlier promotion; nevertheless, their expert knowledge bears fruit when selections are made for certain higher posts of the service.

With the personnel at our disposal, and a naval administration which does not hesitate to throw down the barriers of prejudice standing in the way of sound progress, may we not look to doing "one better" than any competitor in the naval world? The answer is, Yes, if the voice of science is clearly heard in its proper place.

THE NATIONAL PHYSICAL LABORATORY.

THE report of the National Physical Laboratory for the year 1903, which was submitted to the Board last Friday, is the first report covering a full year's working, and shows that very satisfactory progress is being made. It is clear, however, that on the financial side the laboratory is in need of further support, even if it is only to continue to work as at present, whereas it is eminently desirable that the work should be widely extended so that the laboratory can undertake to carry out a number of tests for which there is a demand, and which it is now obliged to refuse. These will in many cases necessitate a considerable increase in the equipment, which is at present very inadequate in many branches, and naturally also an increase in the annual expenditure, which will be only partially recouped by the fees derived from the tests carried out. It is also pointed out in the report that the staff is not large enough, and that the income should be sufficient to allow of higher salaries being paid to the assistants, as those which are at present paid are not liberal enough to secure the permanence of the services of men of the necessary ability.

The net result of last year's working was a loss of a little more than 100*l*., the receipts being, in round figures, 10,200*l*., and the expenditure 10,306*l*. The president and council of the Royal Society have been in communication with the Treasury, and it has been arranged that the grant of 4000*l*. shall be continued for another year (until April, 1905), and also that a scheme for the future working shall be drawn up by the executive committee for the consideration of the Treasury. It is earnestly to be hoped that satisfactory arrangements will be made, and that the very valuable work which the laboratory can perform in the future will not be crippled for want of funds. It is interesting to compare the Government grants to similar institutions abroad which are stated in the report. The Reichsanstalt alone enjoys a grant of 16,000*l*., the total grant to the various departments at Charlottenburg doing the same work as the National Physical Laboratory being 40,000*l*. In America the grant to the Standards Bureau is 19,000*l*., and in France the Laboratoire d'Essais had a grant of 5500*l*. for its first year's working.

If we turn, however, from these financial considerations to the technical parts of the report, we find nothing to cause dissatisfaction, but, on the contrary, a record of very valuable work accomplished. The laboratory has a double function to perform; it has to carry out tests, measurements and standardisations for the public, and it has also to undertake research work, often of a very difficult character, in connection with these measurements. Many of the tests which the laboratory is asked to make are, as a matter of fact, researches in themselves; some of these are quoted in the report, and we may mention, as an example, a series of comparative tests on the materials used for lagging steam pipes. But apart from these there is a vast amount of experimental work to be done in connection with the fixing and reproduction of primary standards of all sorts, and it is very gratifying to see that attention is being given to these questions in a manner which gives promise of excellent results in the near future. We cannot refer to all the work of this kind which has been undertaken at the laboratory but may mention a few typical examples.

Experiments have been carried out on the mercury standard of electrical resistance, eleven resistance tubes having been constructed by Mr. Smith. The results of the measurements made with these tubes show that they agree among themselves to about 3 parts in 100,000, and that the final result agrees with that of the Reichsanstalt to about 1 part in 100,000. Experiments on the standard (Clark) cell have shown that impurities left in the mercurous sulphate have a considerable effect on the value of the electromotive force; it is hoped that a standard method of purification leading to consistent results will eventually be obtained; at present it is stated that the general result of the work carried out and the tests on cells submitted for standardisation show that the Clark cell cannot be regarded as a trustworthy standard. The laboratory has also under construction a standard ampere balance, and when this is completed a Lorenz machine, to be presented by the Drapers' Company, can be taken in hand. The laboratory will thus in time be in a position to give final authoritative determinations of the three fundamental electrical units.

As typifying research work of a somewhat different character, we may refer to the work which the laboratory is doing in connection with photometry. This is a subject in which the only standard we possess—the pentane lamp—is at best only a secondary standard, and one of a very unsatisfactory character. Work is being carried out in connection with the variation of this standard with the barometric pressure, and with the amount of carbonic acid and water vapour present in the air. The result of these researches may lead to a more accurate definition of the conditions for using the pentane lamp, but the laboratory also proposes to undertake experiments on some more definite standard, such as the radiation from a square centimetre of glowing platinum or from a perfectly black body at a definite temperature, which may lead to the establishment of a standard which can be regarded more as a primary standard. It is to be noted that the laboratory is using large bulb electric lamps as secondary standards, and it is probable that these will prove more satisfactory than the pentane lamp, especially as a standard which requires a chemical analysis of the atmosphere every time it is used will not be very practicable. Another research of very great practical importance, which is being carried out by Dr. Harker, is the investigation of the various methods of measuring high temperatures; an examination has already been made of the relative merits and accuracy of the different methods available for measurements up to 1100° C., the results of which have

been communicated to the Royal Society, and Dr. Harker is now engaged in carrying the investigation further—up to temperatures between 1000° C. and 2000° C. This research includes an examination of the thermoelectric force of various platinum and platinum-alloy junctions, and of the effects of small percentages of impurity. The results of this work should be of high value to a great number of industries.

We have referred more especially above to the work which is being done in the physics department, but we might equally have quoted from the work of the other departments. For example, in the engineering department important work is in hand in connection with wind pressure, with the specific heat of superheated steam, and with the determination of the physical properties of a series of nickel-steel alloys prepared for the laboratory by Mr. Hadfield. Similar examples might be taken from all the other departments, but space does not permit us to enter into further detail, and we must refer those particularly interested to the report, which is itself very condensed. Sufficient has been said, we trust, to give some idea of the importance of the work which the laboratory is carrying out and of the progress which has been made. It seems that the value of the institution is likely to be fully recognised by the technical public if one may judge by the steady increase in the number of tests which have been carried out. In 1902, during nine months' working, 209 tests were made; last year this number increased to 1330, which is equivalent to an increase of nearly 300 per cent.

MAURICE SOLOMON.

FERDINAND FOUQUÉ.

By the death of this illustrious geologist and mineralogist the ranks of science have lost one of their most notable chiefs. Half a century has passed away since he began that remarkable series of investigations which have contributed in so large a measure to the progress of vulcanology and petrography. In 1854, associated with St. Claire Deville, he published his earliest experiments on the losses effected by heat on minerals, but he was soon led into the domain of volcanic geology by studying the combustible gases given off from the flanks of Vesuvius. The eruption of Etna on January 31, 1865, furnished him with opportunities of investigating the phenomena of a volcano in full activity, and the series of communications to the Paris Academy of Sciences recording his observations and deductions established his reputation as an accurate and accomplished chemist and mineralogist. The following year came the famous outburst of Santorin, and Fouqué, who had now taken enthusiastically to the subject, hastened to profit by the rare opportunities which this eruption afforded for the detailed study of volcanic phenomena. For several years he continued to publish the results of his visit and of his analyses of the rocks and gases which he had collected, finally embodying the whole elaborate investigation in his great monograph "Santorin et ses Eruptions," which appeared in 1879, and was at once hailed as one of the most important treatises that had yet been written in the domain of vulcanology.

While these studies were in progress he applied the modern microscopic methods to the investigation of volcanic rocks. After some years of successful labour in this field he associated himself with M. Michel-Lévy, whose powers in the determination of the optical characters of minerals and the minute structure of rocks pointed him out as an admirable colleague in such a domain of research. Fouqué had given himself with the utmost ardour to the investigation of the optical characters of the felspars, a research in which he employed all the resources of modern chemistry and microscopy, which engaged his time and thought for some twelve years, and on which he justly prided himself as his most original contribution to science.

In the course of these inquiries his attention and that of his fellow-worker were directed to the importance of endeavouring to imitate the processes of nature by reproducing minerals and rocks artificially. In 1878 he published his "Synthesis of the Felspars," and in subsequent years the experiments were continued by the two observers through a series of trials in which they successively produced, by fusion and cooling, artificial compounds which, alike in chemical composition and minute structure, precisely resembled basic igneous rocks. From pyroxenic labradorite they were led to obtain in succession artificial leuco-tephrites, like the lavas of Vesuvius, basalts, diabases, dolerites and ophitic meteorites. The results of these researches were collected in the memorable "Synthèse des Minéraux et des Roches," the appearance of which in 1882 marked an epoch in experimental geology. Up to the end, however, it was found impossible to reproduce artificially the acid rocks of granitic type.

MM. Fouqué and Michel-Lévy, while engaged in these inquiries, found also time for a detailed study of the minute structure and composition of the crystalline rocks of France, and embodied the results of this laborious investigation in the great quarto monograph "Minéralogie Micrographique: Roches éruptives Françaises," which, with one volume of text and another of admirable coloured plates, was published by the Geological Survey of France in 1879.

The eminent petrographer was not merely one who relied on all the resources of a well equipped modern laboratory. He studied his subject in the field also. One great element of value in his volcanic investigations arose from personal acquaintance with the phenomena of active volcanoes. His knowledge of the eruptive rocks of his native country was likewise widened by prolonged examination of them on the ground. To him we owe some of the most interesting sheets of the map of the volcanic region of central France, where he traced the relations and order of sequence of the volcanic eruptions which give that part of the Continent such absorbing and perennial interest.

In his early years he had given some attention to the phenomena of earthquakes. Hence when the French mission was dispatched to study and report on the phenomena of the Andalusian earthquake of December 25, 1884, Fouqué was placed at its head as director, associated with some of the ablest geologists in France. The massive quarto memoir containing the report of this mission is specially notable for the record of the experiments made by MM. Fouqué and Michel-Lévy to determine the rapidity of the propagation of waves of shock in different kinds of rocks. Fouqué likewise showed his continued interest in this subject by contributing in 1888 a little popular treatise, "Les Tremblements de Terre," to the *Bibliothèque Scientifique Contemporaine*.

For many years past the professor had given courses of lectures at the Collège de France, where also he carried on his chemical and petrographic researches. He lectured with his usual clearness and earnestness on Saturday, March 5. On the following evening he seemed in his usual health, and discussed petrographical subjects with his son-in-law, Prof. Lacroix, but next morning (March 7) he passed away in his sleep at the age of seventy-five.

Gentle, modest and retiring, absorbed in his work, careless about worldly applause, and always happiest in the midst of his charming family, Fouqué was an example of one of the best types of a scientific man. His death makes an irreparable blank in the scientific society of Paris, and has filled with sorrow the heart of everyone who had the privilege of his friendship.

A. G.

NOTES.

A MEMORANDUM by the financial secretary to the Treasury explaining the estimates for Civil Services and the Revenue Departments, 1904–5, was issued on Tuesday. The estimate for education, science and art, is 15,798,217*l.*, which is an increase of 1,217,893*l.* above the amount for 1903–4. The 1903–4 figures include a supplementary estimate of 45,000*l.* for the relief of the National Antarctic Expedition—a service of a quite exceptional character, for which any provision that may prove to be necessary next year will be made in a similar form. The bulk of the addition arises on the vote for the Board of Education, as the result of recent legislation, but Public Education (Scotland), Public Education (Ireland), and Universities and Colleges (Great Britain) also show increases. The Board of Education (England and Wales) requires 985,131*l.* more than this year. Of this increase 50,580*l.* is for grants for training teachers, pupil teachers, &c., and 52,303*l.* for grants in respect of education other than elementary. The principal increase, however (889,888*l.*), is for grants towards expenditure on public elementary schools. Universities and colleges, Great Britain, will require an additional 32,100*l.* to provide for grants for the new universities at Liverpool and Leeds (for each of which 2000*l.* is included), and for the proposed augmentation of the grants in aid of colleges, for which 54,000*l.* is inserted, or double the amount voted in the current year.

A REUTER telegram from Vienna, dated March 19, states that at the request of the Academy of Science, the Austrian Minister of Agriculture, in order to facilitate the solution of certain important questions relating to the nature of radium, has ordered that from January 1 last until further notice no trading should be permitted in the residues from the manufacture of uranium colours at Joachimsthal, and that 10,000 kilogrammes of those residues should be reserved for purchase by the academy and another 10,000 kilogrammes for M. and Madame Curie, in Paris. These consignments are to be devoted entirely to the purpose of scientific experiment.

AT Paris on Friday last M. and Madame Curie were honoured by the Municipal Council at the Hôtel de Ville, and congratulated on their researches on radium. The two investigators were presented with silver medals bearing the inscription, "City of Paris to M. Pierre Curie and Mme. Marie Curie, Laureates of Nobel prize in 1902."

THE *Washington Evening Star* states that the U.S. Congress has granted 5000*l.* for the continuation of Dr. S. P. Langley's experiments on aërial flight.

PROF. ABBE, professor of physics at Jena, and Prof. Neumann, professor of mathematics at Leipzig, have been appointed members of the Bavarian Maximilian Order for Science.

THE *British Medical Journal* announces that two distinguished physiologists, Prof. Luigi Luciani, Rome, and Prof. Angelo Mosso, Turin, have been named Senators of the Kingdom of Italy.

THE death is announced, at the age of sixty-five, of M. Jules Garnier, known for his explorations in New Caledonia and for his geological map of this district. His discovery of nickel ores in this French colony popularised the use of nickel in France, and was thus of material advantage to the colony. He was one of the founders of the French society of commercial geography.

A NUMBER of letters have been appearing in the *Times* with reference to the electric railways to be constructed in the heart of the Snowdon district, which, it is urged by several correspondents, will greatly impair the natural beauties of the neighbourhood. The scheme includes the electrification of the narrow gauge "toy" railway from Dinas to Snowdon, the extension of this line through Beddgelert to Portmadoc, and also the construction of a branch line from Beddgelert through Pen-y-gwryd and Capel Curig to Bettws-y-Coed. These extensions have been sanctioned by the Light Railway Commissioners, and a Bill for a further extension from Dinas to Carnarvon was before a House of Lords Committee last week, the preamble of which it found proved. The railway will thus not only serve a district largely frequented by tourists, but will enable the slate from the quarries to be brought down easily to Carnarvon without the two or three changes of conveyance now necessary. It is also proposed to supply power to the quarries; the power is to be obtained from Llyn Llydaw, on the slopes of Snowdon, whence a pipe line will be run to the nearest point on the railway at which a generating station will be built.

THE completion of the electrical equipment of the Liverpool and Southport line of the Lancashire and Yorkshire Railway must be regarded as an important step in the progress of steam railway electrification. This is the second steam railway to be electrified, but the change is of more importance in this case than in that of the Mersey Railway on account of the fact that it is likely to lead to the electrification of all the suburban lines of the Lancashire and Yorkshire Railway, and possibly also of the London and North-Western Railway. The section which has just been electrified is nearly twenty miles in length, and has to deal almost entirely with passenger traffic. The effect of the electrification will be nearly to double the number of trains running between the two termini, and to reduce the time taken over the journey from 54 to 37 minutes. Power is generated at Fromby, nearly at the middle of the line, at 7500 volts three-phase; this is transformed down and converted to continuous current at 600 volts, at which pressure the train-motors are supplied. The current is collected from a third rail outside the track rails, and each train has two motor-cars, one at each end, with two trailers in between. It is pleasant to note, considering that all our electrical tramway equipment has been borrowed from America, that the whole of the equipment of this line is of English design and manufacture, the rolling stock having been made by the railway company, and all the rest of the work executed by Messrs. Dick, Kerr and Co.

THE figures published by Mr. J. W. Bradley, engineer to the City of Westminster, giving the results of tests on the different lamps employed in street lighting, are exceedingly valuable as the tests are made under actual working conditions and include all costs of maintenance, interest on capital, sinking fund, &c. The results of the sixth series are published in the *Electrician* of March 11. From this series of tests Sugg's high pressure lamps in Parliament Street come out cheapest (7·65 pence per candle-power year), the arcs on the Westminster Supply Corporation

being second best (8·73 pence per candle-power year). As the average of the six series of tests, however, this order is reversed, the arcs being cheapest (8·7 pence) and the incandescent gas second (9·85 pence). It is to be noted, however, that the cost of the arc lighting seems to vary considerably with the type of lamp and conditions of contract; there are three different electricity supplies in the City of Westminster, and the cost of the arcs on these three supplies is respectively 11·5, 15·1 and 8·7 pence per candle-power year. The triple flat-flame burners in the Strand cost 47·5 pence, and, indeed, there is apparently no other form of lighting that can compete with the arcs or Sugg's high pressure burners.

THE report of the departmental committee on the use of electricity in mines which has recently been published is likely to be read with the greatest interest by all electrical and mining engineers. There can be little doubt that electrical machinery, which is already in considerable use in mining both here and abroad, is destined to play a still more important part in the future. The extreme flexibility of an installation of electric power is particularly advantageous in mining work, and numerous machines for performing the heavier mining operations have been constructed. The objection on the score of danger, especially in mines liable to an explosive atmosphere, is not in reality a serious one, as proper design and supervision of the machinery are easily obtained. The proposed rules which have been drawn up at the end of the report referred to above, though at first reading they may seem too stringent, should have the effect of ensuring the safety of the miners and of begetting confidence in electrical working, so that one may hope that the report will stimulate the application of electricity to mining.

DR. C. BARUS, of Brown University, Providence, R.I., has sent us several photomicrographs of fog particles condensed on X-ray and other nuclei. Unfortunately the details of the photographs are too fine to be reproduced satisfactorily in these pages. The nuclei were produced by passing the X-rays for from one to ten minutes through saturated dust-free air in a large condensation chamber. The nearly cubical chamber was made of wood impregnated with resinous cement, lined with a double layer of *wet* cotton cloth, and provided with faces of plate glass. The particles were caught on a plate of microscope glass covered with an oil film and exposed to the subsiding fog for thirty seconds. The plate was then adjusted for photography in the ensuing thirty seconds. In one photomicrograph fog particles of all sizes from about 0·0005 cm. to 0·0020 cm. are present, indicating a similar gradation of nuclei. Extremely fine fog particles (0·0003 cm. to 0·0009 cm. in diameter) appear on another picture corresponding to the large green-blue-purple corona, and are due to condensation on phosphorus nuclei. Dr. Barus hopes to apply this photographic method to the study of atmospheric nucleation, and thus to obtain those important but small qualitative differences of nucleation which must vanish from the corona as a whole.

REFERENCE is made in the *Times* of March 9 to a despatch which has been received by the India Office in which the Indian Government indicates the methods by which it hopes to effect an improvement in the quality of exported Indian cotton. The most difficult question, and one for which no remedy has been found, is how to prevent the admixture of inferior grades in the packing. The other problem which is engaging the attention of the Government is concerned with the improvement of the seed so that the cotton obtained may be of better quality. The acclimatisation of foreign species has not been attended with much success, but the Government now hopes to attain its object by the improvement of some of the indigenous species either by selection or by hydridisation. Experiments are in progress at Surat, and also in Behar, in the United Provinces, and in the Punjab.

IT has generally been assumed that in the wood of trees, especially the heart-wood, the cell-walls are entirely lignified, so that the paper contributed by Prof. M. C. Potter to the *Annals of Botany*, in which he gives proof of the cellulose-staining qualities of the walls of some cells, even in the heart-wood of trees forty and sixty years old, will lead to a modification of present conceptions. Another fact emphasised in the paper, but which has been known since Hartig treated the subject in 1878, is the digesting action of certain fungi by which lignin is changed into cellulose compounds, and, as Prof. Potter shows, the same result is obtained by steaming wood, the explanation being that the water extracts from the wood the substance which gives the characteristic lignin reaction.

THE vital importance to farmers of a thorough knowledge of the habits of the insects which damage their crops and granaries is gradually being recognised by all civilised nations, and Italy is now taking up the matter in real earnest. From that country we have received Nos. 7 and 8 of the second series of the *Bolletino* of the Royal Higher School of Agriculture in Portici, the former dealing with insects injurious to stored grain, and the latter with the scale-insects of the genus Diaspis. Both are illustrated.

FROM the U.S. Department of Agriculture we have received two *Bulletins* issued by the division of entomology. In the one Mr. F. M. Webster treats of insects attacking the stems of growing cereals and the best means of destroying them. It appears that in the States the injuries inflicted on corn-stalks by no less than eight species of minute flies are all laid to the charge of the Hessian fly, and it is the object of the paper to point out how these different species and their modes of attack can be distinguished from the latter. In most instances the ravages of these insects can be prevented or mitigated by very simple measures. The second paper, by Mr. F. H. Chittenden, is devoted to the insect enemies of the sugar-beet. Although the beet-sugar industry is still in its infancy in the States, about 150 species of insects are known to prey on beet, and although comparatively few of these inflict serious losses, there is little doubt that, as the cultivation of this crop increases, other kinds will use it as a food-supply, so that more extensive injuries may be looked for every successive season.

WHATEVER difference of opinion may exist as to the advisability of the restricted sense in which mammalian generic names are now employed by a number of zoologists, and likewise with regard to the revival of obscure and frequently "barbarous" names for such genera, absolute unanimity must prevail among all naturalists as to the value and importance of a thoroughly complete and trustworthy list of all the generic names for mammals which have ever been given. Such a list has been compiled, with immense labour, by Mr. T. S. Palmer, and forms No. 23 of the "North American Fauna," in course of publication by the Biological Division of the U.S. Department of Agriculture. When it is stated that up to the end of 1900 more than 4000 generic names for mammals had been proposed, and that more than 100 new ones were added in 1901, some idea of the magnitude of Mr. Palmer's task may be gleaned, although only

those who have been accustomed to work of this nature are able to appreciate this fully. This is, however, by no means all, for the list before us differs from most of its predecessors in giving the family and ordinal groups to which the various genera respectively belong, thus not only greatly increasing the labour, but likewise vastly enhancing the value of Mr. Palmer's "Index."

UNDER the title of "On Humanising the Animals," Mr. J. Burroughs, in this month's issue of the *Century*, continues his protest against the practice of attributing human powers of thought and prescience to animals. While admitting that the example of parents stimulates the imitative instincts of their offspring, the author insists that teaching—in the sense of imparting true knowledge—is conspicuous by its absence in all animals. Such communications as do pass between animals (and means of communication undoubtedly exist) relate only to the present, and have no reference to either the past or the future. Hence they come under the denomination of feeling or emotion, in contradistinction to knowledge. Such communications are, however, undoubtedly of value to the young, which always thrive far better when reared by their parents than when brought up by hand. As regards the means by which large bodies of animals, such as flocks of starlings or peewits, herds of deer or antelope, or shoals of herring or mullet, act in complete unison, as if acting under the influence of a leader or a code of instruction, the author is inclined to attribute the phenomenon to something analogous to telepathy in mankind. "There is nothing," he writes, "in this state of things analogous to a military organisation. The relation among the members of the flock is rather that of creatures sharing spontaneously the same subconscious or psychic state, and acted upon by the same hidden influence, in a way and to a degree that never occur among men."

THE development of the giant salamander (*Megalobatrachus maximus*) of Japan forms the subject of a paper by Dr. C. Kerbert, of Amsterdam, in No. 10 of vol. xxvii. of the *Zoologisches Anzeiger*. A female at Amsterdam laid a number of strings of eggs, which were deposited in a heap at the bottom of the water. As they lay there, the male on two occasions forced himself into the midst and communicated a vibrating motion to the whole mass, apparently to allow a free percolation of water between the eggs. This constitutes a new phase of the many examples in which male amphibians assist in the care or hatching of the eggs. The newly-hatched tadpoles have three pairs of external gills, and are remarkable for the circumstance that the extremities of the anterior limbs are bifid. The figures of certain newly-hatched tadpoles reproduced by the Messrs. Sarasin as those of the giant salamander have been shown to belong to *Onychodactylus japonicus*, and Dr. Kerbert's specimens are therefore the first examples at this age known to science.

LAST May Major Leishman, R.A.M.C., described certain bodies which he believed to be parasitic in nature, and which were obtained from a case of fever with enlarged spleen (not malaria) contracted in India. These bodies have since been studied by Donovan, Laveran, Ross, and Manson and Low in cases of the disease known as kala azar. The parasite is a small rounded or ovoid body about $3-7\mu$ in diameter, and either free or embedded in a matrix, in which case as many as twelve may be present in one mass. Each body consists of a larger and of a smaller mass of chromatin, and the free forms are encapsuled. These bodies have so far not been met with except in the spleen. Leishman at first believed that they were degenerate trypanosomes, Laveran has placed them in the genus Piroplasma, but since they are not intracorpuscular this hardly seems to be correct, and Ross now considers that they may belong to a new genus of sporozoa, and suggests for them the name *Leishmania donovani*.

WE have received from Mr. E. Philip, of Cardiff, a form of spinthariscope called Perman's radioscope, which gives the now well-known scintillations on a blende screen with marvellous brilliancy. The following statement is made in the circular which accompanied it:—"The effect is somewhat the same as in Crookes's spinthariscope, but the radium is spread over a larger surface and produces a very pleasing and striking appearance, resembling a multitude of bright stars twinkling brilliantly in a dark sky. Moreover, in different instruments different effects are produced owing to differences in the arrangement of the radium salt. The effect is produced by the radiation from the radium known as the α-rays, which consist of minute particles of atomic size; these are projected forth with great velocity, and when they strike the blende screen cause cleavage of the minute crystals which they meet, the cleavage being accompanied by a flash of light or scintillation. These or similar scintillations are being constantly produced spontaneously in hexagonal blende, and can be seen at any time, when the eye is sufficiently sensitive, by looking into a radioscope tube *without any radium*; but under the influence of the radium they are increased enormously in number and brightness." In the specimen forwarded to us sufficient variation of focus to suit different eyes is not provided.

THE *Quarterly Journal* of the Geological Society for February contains a short but interesting article by Mr. and Mrs. Clement Reid on their discovery of a probable Palæolithic floor at Prah Sands, about seven miles east of Penzance. This ancient floor was shown to overlie the raised beach, which rests on an uneven rocky platform that is about 15 feet above high-water mark. The floor is formed of loam which at one time was a true land surface, as it is full of small vertical roots. Towards the top of it is a black layer, with fragments of charcoal, burnt bone, and burnt earth. The authors conclude that here is evidence of a land surface on which Palæolithic man made hearths and lighted fires. They found also in this black layer pieces of vein-quartz, apparently fashioned into rude implements. Above this earthy deposit was a thick mass of angular detritus or "head," which was banked up against the old sea-cliff, and is generally considered to belong to the later stages of the Glacial period. In the same *Journal* Mr. E. T. Newton records the discovery, for the first time in Britain, of the remarkable genus of fishes known as Edestus. It was obtained from the Coal-measures of north Staffordshire. Prof. J. W. Gregory writes on the Glacial geology of north-west Tasmania in a well illustrated article, in which he shows that the lowest level at which evidence of Pleistocene glaciers has been found is 400 feet above sea-level. There is, however, evidence of more recent uplift of the land.

PROF. S. P. LANGLEY'S biographical notice of James Smithson, the founder of the Smithsonian Institution at Washington, has been reprinted from "The Smithsonian Institution, 1846–1896: the History of its First Half Century," edited by the late Dr. G. Brown Goode.

A SECOND edition of Dr. Holmes C. Jackson's "Directions for Laboratory Work in Physiological Chemistry" has been published in New York by Messrs. John Wiley and Sons, and in London by Messrs. Chapman and Hall, Ltd. The book has been thoroughly revised, and numerous additions have been made to the subject-matter.

We have received a copy of the first issue—that for 1903—of *Mimir*, which is wholly concerned with Iceland and Icelandic institutions. The annual publication is intended to help Icelandic research, to keep the people of Iceland and the foreign student informed of the progress of this research, and to promote the proper development of the island and its people. Among the interesting contents we notice the account of institutions in Iceland, the addresses of foreign students of Old-Northern letters, and numerous notes on Icelandic matters of general interest. *Mimir* is printed in English, and is published by Martius Truelsen, of Copenhagen.

The tables relating to the output of coal and other minerals and the number of persons employed at mines worked under the Coal and Metalliferous Mines Regulation Acts during the year 1903 have now been printed. The tables have been prepared by direction of the Home Secretary from returns furnished by H.M. Inspectors of Mines; and they form part of the general report and statistics for 1903 of mines and quarries. The output of coal from mines under the Coal Mines Regulation Act, which was 227,084,871 tons in 1902, was 230,323,391 in 1903, showing an increase of 3,238,520 tons. The number of persons employed at these mines in 1903 was 842,066, an increase of 17,275.

Two new general methods of preparing aldehydes are given in the current number of the *Comptes rendus*. The first of these, by M. E. E. Blaise, consists in the conversion of the acid through its bromine derivative into the corresponding α-hydroxy-acid, which by the action of heat is first converted into a lactide, and this on distillation splits up into carbon monoxide and the aldehyde of the next lower acid. The yields are very good, from 50 to 60 per cent. of the acid employed, and from the results obtained would appear to be generally applicable to the higher fatty acids. The second method, published by M. F. Bodroux, is based upon the action of magnesium alkyl compounds in toluene solution upon ethyl orthoformate. Here again the reaction gives good yields—from 55 to 75 per cent. of the theoretical—and the examples given by the author include members of both the fatty and aromatic series.

The Geneva *Archives des Sciences* for January contain an important article on the theory of nickel steels, by M. Guillaume, of the Bureau international des Poids et Mesures. One of the most important properties of these alloys is their low coefficient of expansion, which becomes zero at about 36 per cent. of nickel. It is pointed out that the conversion, below 890° C., of the hard, non-magnetic γ variety of iron into soft, magnetic α iron is accompanied by an expansion of 3 mm. in a rod a metre long. The addition of nickel lowers the transition temperature until in presence of 20 per cent. of nickel magnetic properties only appear when the alloy has been cooled below 200°, whilst (owing to a kind of thermal hysteresis) the magnetic properties do not disappear again until the alloy has been heated to 600° C. In the non-expansive alloys the transition temperature appears to have been brought down to atmospheric temperatures, and the constancy of length is attributed to the same change in structure as that which causes the abrupt expansion in pure iron when cooled below 890°. A striking proof of the correctness of this view was obtained by cooling a metre rod in liquid air, when it suffered a permanent expansion of 3·9 mm., and subsequently showed the high coefficient of expansion characteristic of α iron in place of the lower coefficient characteristic of γ iron.

The additions to the Zoological Society's Gardens during the past week include a Green Monkey (*Cercopithecus callitrichus*) from West Africa, presented by Mrs. L. A. Moline; a Vervet Monkey (*Cercopithecus lalandii*) from South Africa, presented by Captain Campbell; two Eastern Sarus Cranes (*Grus antigone*) from Northern India, presented by Lieut.-Colonel H. H. Smyth; a Greater Sulphur-crested Cockatoo (*Cacatua galerita*) from Australia, presented by Mr. C. Hammett; a Hybrid Pheasant (between *Phasianus reevesi* and *Euplocamus nycthemerus*), presented by the Earl of Ducie; two Ring-tailed Lemurs (*Lemur catta*) from Madagascar, an Azara's Opossum (*Didelphys azaroe*) from South America, a Blue-necked Cassowary (*Casuarius intensus*) from New Guinea, four Dusky Francolins (*Pternistes infuscatus*), two Jackson's Francolins (*Francolinus jacksoni*), two Schueth's Francolins (*Francolinus schuethi*) from East Africa, two Hybrid Parrakeets (between *Platycercus semitorquatus* and *P. barnardi*) from Australia, deposited. In additions in last week's issue (p. 473), Snow Leopard presented by Major Cox should read Major Mackintosh.

OUR ASTRONOMICAL COLUMN.

Variations of the Martian Canals.—During the 1903 opposition of Mars, Mr. Lowell observed changes in the canals which he believes were the results of artificial interference. Among the canals mapped by Schiaparelli in 1877 were three, situated on the eastern edge of the Syrtis Major, which met at a common point, the Lacus Tritonis, and which he named Thoth, Triton and Nepenthes respectively. In 1882 and 1884 Thoth appeared double, but was undoubtedly seen, and in 1884 Nepenthes was also distinctly double.

At the commencement of Mr. Lowell's observations in 1894 he was surprised to find no trace of these three canals, or of the Lacus Moeris, a widening of Nepenthes, although other well known but smaller features were plainly visible. Instead of Thoth another canal, which he named Amenthes, appeared, running from Syrtis Minor to the Aquæ Calidæ, nearly parallel to the earlier recorded directions of Thoth and Triton. During the oppositions of 1896–7 and 1901 this continued as an easily seen object, and Mr. Lowell concluded that it was really Thoth which had been wrongly placed on the earlier drawings. During February and March, 1903, Amenthes was still visible but less distinct, and on April 19 it was accompanied by Thoth in exactly the position shown on Schiaparelli's earlier map; on April 20 Thoth alone was visible. Suddenly, on May 29, the Lacus Moeris, which had long been given up, appeared and became a noticeable feature of that region of the planet's surface. In July Amenthes reappeared alongside Thoth and Triton, and thus settled the question of the presence of *two* canals.

These changes are entirely independent of the seasonal changes, and whilst the two "visibility" curves of Thoth and Amenthes vary inversely, the curve derived from the summation of them agrees very closely with that of a "mean" canal, for which only the seasonal changes have as yet been observed.

From these phenomena Mr. Lowell reasons that owing to the small amount of water on Mars it becomes necessary to irrigate the surface in sections, and for this purpose the canals are artificially regulated, Thoth and Amenthes being allowed to fill up and irrigate the regions surrounding them alternately (Lowell Observatory *Bulletin*, No. 8).

Prof. Burnham's Measures of Double Stars.—One of the *Decennial Publications* (vol. viii.) of the Chicago University is devoted to a record of the measures of double stars made by Prof. S. W. Burnham with the Yerkes 40-inch refractor during 1900 and 1901. The systems which have been measured are those which have been long neglected and are little known, and those which, from the few early measures or the uncertainty of their results, could not be classified as to their motion or otherwise. Most of the pairs were selected from the Herschel and South cata-

logues, whilst some of the rejected Struve stars have also been measured.

Eighteen new pairs discovered by Burnham are also included. The pairs are arranged in order of R.A., and the coordinates (for 1880·0), the number in the original catalogue, and the measures of position angle and distance are given.

ORIGIN OF AURORÆ.—In a lengthy communication to the Société Française de Physique (*Bulletin* No. 3, 1903), M. Ch. Nordmann discusses the causes which produce auroræ. After reviewing the various observations of the phenomena attending auroræ, and discussing in detail the theories of Arrhenius and Birkeland, he formulates his own theory in the following words:—"I think that the Auroræ Boreales are luminous phenomena produced in the upper atmosphere by the Hertzian waves emanating from the Sun."

In support of this belief he discusses each of the phenomena attending the appearance of auroræ, and shows that the forms and orientation, the extension, the frequency, the height, the spectrum and the diurnal, annual and undecennial periodicities may all be explained by the application of his theory. In discussing the relations between auroræ, solar disturbances and magnetic storms, he states that the emission of the Hertzian waves becomes more intense in the regions of spots and faculæ at the period of maximum solar activity, and quotes the observed fact that it is only the rapidly moving auroræ (*i.e.* those due to the greater disturbances) which apparently affect the magnetic needles.

ASTRONOMICAL DETERMINATION OF LATITUDE AND AZIMUTH.—In a recent publication of the Royal Geodetic Commission of Italy, Prof. V. Reina gives the details and the results of the astronomical determination of the latitude and azimuth of five selected stations situated near to the meridian of Rome. The main object of this determination was to study the action of the local attraction on these two coordinates. A number of circum-meridian observations of certain fundamental stars were made at each station, and the results are given separately. Auwers's correction to the astronomically determined position is then applied, and the final results are embodied in a table, which also shows the reduction of each position to the "mean pole," the effects of local attraction, and the differences between the results of the astronomical and geodetical determinations.

THEORIES OF THE RESOLVING POWER OF A MICROSCOPE.[1]

GEOMETRICAL optics in its relation to instruments has been studied to great advantage abroad; we in England have of recent years somewhat neglected the subject, with the result that only a small share in the recent advance in lens construction has been ours. The books and papers under review tell us of the advance.

It was in 1878, in his report on the London International Exhibition of Scientific Apparatus, that Prof. Abbe first directed attention to the fact that the further perfection of the microscope as an optical instrument depended on the advance of the art of glass making. With the glasses then at their disposal it was not possible for opticians to get rid of the secondary spectrum of their object glasses; while a glass could be made achromatic for two wave-lengths, the differences in the relative dispersion of the two ends of the spectrum were such that there was an outstanding amount of colour which prevented the attainment of the highest perfection of the image. It was to this fact that the establishment of the now celebrated firm of Schott and Company was due, and the results of Abbe's own work on microscope lenses are summed up in the first volume of his collected papers, which has recently appeared.

The well-known paper, "Contributions to the Theory of the Microscope and of Microscopic Perception," which forms the basis of his work, is here reprinted, and it will be interesting to consider some of the points it raises.

But first let us contrast what is now possible so far as achromatic correction is concerned with what was possible, say twenty years ago. In those days the ordinary flint and crown glasses only were available. In the case of a telescope object glass with a focal length of one metre for the D line, the variation in focal length will, with such glasses, amount to 1·4 millimetres for A′ and 2·2 millimetres for G′. In an object glass using modern glass, such as that designed by Mr. H. D. Taylor, these errors are reduced respectively to −0·1 millimetre and +0·3 millimetre.

These figures are enough to show how much the optician owes to the art of the glass maker.

Turning now to some theoretical matters connected with the microscope which are dealt with by Abbe in his papers, let us consider first the term numerical aperture in its relation to the resolving power of the instrument. We owe to Abbe the introduction of this term, and the realisation of its importance as defining, in certain circumstances, the resolving power of the instrument. By numerical aperture is meant the value of the quantity $\mu \sin \alpha$, where μ is the refractive index of the medium in which the object is placed, 2α the vertical angle of the cone subtended at the object glass by the point in which the axis of the instrument meets the object. Let us suppose, then, that an object is on the stage viewed by transmitted light, and to simplify matters let us suppose the source of light at some distance.

Then, according to Abbe[1] and his followers, in considering the image formed in the focal plane of the eye-piece we are not to start from the object as a self-luminous source and consider where the image of such a source would be if formed by the laws of geometrical optics; we are to start from the source itself, to consider its image formed in the focal plane of the object glass, and to treat this image as a self-luminous source of light in the microscope tube from which arises the image we see.

If the object be small, the focal image will be modified by diffraction due to the object, and according to the views enunciated in the paper before us, it is on the nature of the diffraction images and the number of them which are formed that the definition depends.

We will return later to the question whether it is necessary thus to consider our problem.

At present let us develop it and examine whether it affords us a satisfactory solution of the problem of resolving power.

Suppose, now, the microscope has been focused on some object on the stage and then this object has been removed; the parallel rays from the source are brought to a focus in the focal plane of the object glass, forming there a circular patch of light; rays diverge from each point of this, and reaching the eye produce the sensation of a uniform luminous field.

Now let the field in the focal plane be limited by diaphragms pierced with a series of small apertures. The distribution of light in the focal plane of the eye lens, the view plane, will be no longer uniform; we shall see the diffraction pattern formed there by the apertures.

If, for example, there be but one aperture, a single narrow slit, the field will still be uniform; light diverges from the slit uniformly in all directions, and no structure is seen.

If we have a number of equidistant slits the view plane will be crossed by a series of equidistant dark and light bars. The distance between these bars and the distribution of light between them will depend on the distance between the slits of the diaphragm and the distribution of luminosity among the slits. If this be known, the distribution of light in the view plane can be calculated. If, for example, the distance between the slits be doubled, the distance between the maxima in the view plane will be halved, that is to say, the number of bright bars in a given interval will be doubled. The distribution in the view plane depends on that in the focal plane, and can be calculated from it; this is quite certain.

[1] "Gesammelte Abhandlungen" Von Ernst Abbe.
"Das Zeisswerk und die Karl Zeiss-Stiftung in Jena."
"Zur Theorie der Mikroskopischen Bild-erzeugung." By Victor Grunberg.
"The Helmholtz Theory of the Microscope." By J. W. Gordon.
"The Theory of Optical Images." By Lord Rayleigh (*Journal* of Royal Microscopical Society, 1903).

[1] It was stated recently by Dr. Czapski (*Proc.* Royal Microscopical Society, August, 1903, p. 569) that it would be a mistake to suppose that Prof Abbe had merely given a grating theory of the microscope; he has treated the matter more fully.

But now, instead of producing a variable distribution in the focal plane of the object glass by means of diaphragms, we can do it by means of the diffraction effects of small objects on the stage.

Thus if we put on the stage a grating consisting of a series of equidistant spaces, and if e be the grating distance, then, taking homogeneous light, a series of narrow bands of light, the diffraction images of the source, will be produced in the focal plane with darkness between them; the central image will be on the axis, and if θ_1 θ_2 . . . be the angular distances between the images, then $\sin \theta_1 = \lambda/e$, $\sin \theta_2 = 2\lambda/e$, &c.

It may be shown that the image in the view plane produced by this series of diffracted images is the ordinary geometrical image of the grating. It should be observed that in this proof there is no discussion of the distribution of light in the interspaces between the maxima, and it is on this distribution that the question of resolving power depends. It is clear, of course, that if we modify the number of spectra in the focal plane we modify the image, and this is done in an ingenious way in some of the experiments arranged by Prof. Abbe's pupils to illustrate the theory.

If we cut out all but the central image the view field is uniform, no structure is visible; if we allow the first image on either side of the central one to become effective, the bands appear in the field in their proper positions, and so on. It is said to be the fundamental result of Abbe's theory that the object, the grating, can be fully resolved if one diffraction image is formed on either side of the central one. It is clear that in this case there will be variations of intensity in the view plane; we shall see later what they amount to.

Now the number of spectra is limited by the fact that some of the diffracted light may be so obliquely diffracted as not to enter the object glass. If 2α be the angular aperture of the object glass measured from the axial point of the stage, then the nth diffracted image will not appear if $\sin \theta_n$ is $>\sin \alpha$, but $\sin \theta_n = n\lambda/e$.

Hence for the nth image to be excluded, $n\lambda/e$ must be greater than $\sin \alpha$, but according to Abbe, for resolution the first diffracted image must appear, and hence resolution is just possible if λ/e is equal to $\sin \theta$.

It has been assumed that air is the medium on either side of the object glass; if on the object side we have a medium of refractive index μ, then it is easy to show that we must replace $\sin \theta$ by $\mu \sin \theta$, and the condition of resolution is that e should be equal to $\lambda/\mu \sin \theta$, or, introducing the term numerical aperture for the quantity $\mu \sin \theta$, we have the result that a grating is resolvable if the space between the lines is not less than the result found by dividing the wave-length of light by the numerical aperture.

Now, while the truth of this result can in certain cases be established, the reasoning given in the books under consideration is insufficient to prove it.

In order to decide if the grating can be resolved we must establish the law of variation of intensity in the view plane, and then consider whether these variations are such that they can be detected by the eye. This has been done by Lord Rayleigh. The images formed in a microscope are, like all other images, produced by interference; in considering resolving power we have to consider diffraction effects it is true, but the diffraction which concerns us mainly is that due to the aperture of the object glass, and only indirectly that due to the object viewed.

Neither is it necessary, if we know completely the distribution of the light over the stage, to go back to the source in our consideration of the problem; having given the distribution over the stage both in amplitude and phase, we are potentially able to determine that in the view plane without reference to the source. Difficulties of calculation may stop us, it is true, but that is another matter.

Let us take, again, the case of a grating illuminated by plane waves, their plane being parallel to that of the grating; we have to consider the effect due to a series of equidistant lines of light; these differ, however, from a series of independent equidistant linear sources in that, with the grating, the phases of the various sources are the same; we have therefore to remember that interference will take place between the light from the different lines, while with a series of independent lines there is no relation between the phases; we can calculate the intensity due to each source separately, and superpose the whole.

Lord Rayleigh's solution of the problem, which is presented when a narrow double line in a spectrum is viewed through a telescope, or when the attempt is made to resolve two close double stars, is better known than his equally valid solution of the grating problem, and as it is simpler it will be useful to indicate it first.

The intensity in the view plane for a single linear source, assuming for the moment that we are dealing with a telescope with a rectangular aperture, is given by a certain curve. If we assume a second independent source parallel to the first we get a similar curve alongside the first. The resultant intensity is found by adding the corresponding ordinates of the two curves, and the lines will appear as double when the drop in the resultant intensity curve is sufficient to be detected by the eye.

Lord Rayleigh suggested that in his case the drop would be just distinguishable when the maximum of intensity due to the second curve was superposed on the first minimum due to the first, and experiment has borne this out. In this case the two halves of the aperture send light in opposite phases to the first minimum, and the angular deflection of the minimum is the angle subtended by the wavelength of light at the distance of the breadth of the aperture. Two lines which subtend a greater angle than this can be resolved.

Similar methods were applied by Lord Rayleigh in 1896 to the microscope, and additional results have been given in his recent communication to the Royal Microscopical Society which follows Mr. Gordon's interesting paper on Helmholtz's theory of resolving power in the *Journal* of the Society. In his paper Mr. Gordon discusses in detail Helmholtz's theory, and points out how far it is from fully explaining all the difficulties of microscopic vision.

In Lord Rayleigh's earlier paper he deals with (1) two independent linear sources viewed through a microscope, and shows that they can be resolved if the distance between them is half that given by Abbe's theory; (2) two sources which are always in the same phase; in this case resolution is impossible if the distance is that given by the theory.

If, instead of having *two* sources, either cophasal or independent, we have a long series, the problem is more complex, but the method is the same. An expression is found for the variations of intensity in the view plane, and the question is considered whether or no these variations are sufficient to be noticed by the eye.

In the paper the question of the visibility of a dark bar on a uniform field is dealt with, and here again a distinction must be drawn between the case in which the field is self-luminous and that in which it is due to a distant source. In the latter case it appears that the image of the bar would be marked by a perceptible darkening across the field, even when the breadth of the bar was but 1/32 of that given by Abbe's theory, though the breadth of this shadow would not be a measure of that of the bar; in the former case the fall in intensity over the geometrical image is only one-half of what it is in the latter. Moreover, we are certain to arrive at erroneous consequences if we apply results obtained from the case of a grating of a large number of parallel slits to a case such as that of a single small aperture through which light is coming or a single small obstacle obstructing the light; the diffraction pattern due to such an obstacle is entirely different from that due to a grating, and the conditions of resolution will be different also.

It appears, then, that while Abbe's theory of microscopic vision is undoubtedly correct in that a small object or objects on the stage produce diffraction patterns in the focal plane of the object glass, and the illumination in the view plane can be inferred from these diffraction images, still this method of regarding the question is not the only possible one, neither is it necessary to go back to the original source if we know the distribution in the object plane. By proceeding, however, in the way indicated by Lord Rayleigh, we can evaluate the distribution of intensity in the view plane, at any rate in certain cases, and obtain thus a numerical estimate of the resolvability. R. T. G.

FROST EFFECTS AT NIAGARA.

MR. ORRIN E. DUNLAP, writing from Niagara Falls, sends us some striking photographs of ice formations noticed at Niagara during the past winter. An ice bridge formed in the gorge below the Falls in December last, and thousands of persons crossed from shore to shore on this curious formation. Another remarkable object was an ice mountain composed of a massive collection of frozen spray

Photo. *O. E. Dunlap.*

FIG. 1.—Mass of Frozen Spray at Niagara.

(Fig. 1). Usually this mound rests on the débris slope between the inclined railway building and the falling water, but last winter it bridged the torrent of the American Fall and extended over in front of the Fall. Here a grotto-like effect was caused by the wearing tendencies of the falling water, and the effect was repeated on the outside, or ice bridge side, of the mountain. From the ice bridge the different layers of ice that went to make up the mound could be distinguished.

A part of the face of the cliff over which the American

Photo. *O. E. Dunlap.*

FIG 2.—Prospect Park as viewed rom Prospect Point. The ice in the foreground is 10 feet thick.

Fall usually flows was hidden under huge icicles that hung from the brink to the talus at the foot of the precipice. In Prospect Park the ice that gathered on the trees was very destructive. The ice grew so heavy that the largest trees lost many branches, and some were left with only their trunks.

The grandest sight of all was, says Mr. Dunlap, at Prospect Point in the middle of February. The wind blew from the south-west, and the spray of the American Fall fell upon the Point, where it was frozen with great rapidity. Every hour added to the mass, until finally it was more than 30 feet high from the water as it plunged over the American Fall. The mound extended back into the park, half burying trees that were already weighted with great loads of ice (Fig. 2). One of the accompanying illustrations shows this ice mound. Realising that the mound might damage the lower section of the inclined railway building or cause loss of life among the many who climbed about the ice and mountain below, it was resolved to try to blast it away. To accomplish this holes were drilled along the upper river side, and eight sticks of dynamite placed in them; but their explosion accomplished little, owing to the slight resistance offered by the ice.

A FORMIDABLE ENEMY TO THE COTTON PLANT.

GREAT alarm has been caused in America by the ravages and rapid spread of a new insect pest, the Mexican Boll-weevil (*Anthonomus grandis*, Boheman), which was described from Vera Cruz in 1843, but first attracted serious notice in the region around Monclova, in the State of Coahuila, Mexico, about 1856, and within six years from that time had devastated the cotton crops to such an extent that the cultivation of the plant was actually abandoned in the neighbourhood. Thence the insect extended its ravages north and east until it reached Matamoras, at the mouth of the Rio Grande, the river which forms the boundary between Mexico and Texas.

In 1892 the weevil crossed the river, and by 1894 had spread throughout the cotton region of southern Texas. In 1804 the damage done in many of the infested districts, both in Texas and Mexico, was estimated at no less than from 50 to 90 per cent., and the American Government was strongly urged by the entomologist who prepared the first official report on the subject (Mr. C. H. Tyler Townsend) to take instant and drastic measures to try to stamp out the pest. However, nothing was done, and with some fluctuations the insect continued to spread, and though the American entomologists reported on it from time to time in "farmer's bulletins" and elsewhere, it was not until June, 1902, that funds were allotted for experiments on a large scale. At present the insect is still confined to Texas, but already the infested area is estimated to include about 1/28th of the whole cotton district of the United States, and there is now no reasonable probability of either stamping out the pest or preventing its extension within the next twenty years over the whole cotton-growing region of the southern United States, nor is there any probability that its attacks will become less serious with the lapse of time. The loss in Texas alone in 1902 is variously estimated at from 8 to 25 millions, and though other causes may have contributed to the deficient crop, there is no doubt that it was largely due to the attacks of the weevil. Still, much can be done by early planting and thorough cultivation, and the destruction of all stalks and other refuse by burning, not later than the end of September. Poison and traps are inefficient, but a cold December and January are very destructive to the insect; nor has it attacked the cotton-growing district of Laguna, in Mexico, which lies at an elevation of 3500 feet.

At length the authorities are roused, and the American House of Representatives has lately passed a Bill for the appropriation of a sum of 250,000 dollars for the extermin-

ation of the pest. But we fear that it is too late now to do more than to oppose the insect by special methods of cultivation, and to institute stringent measures to try to prevent the invasion of districts not yet attacked.

The weevil itself is a greyish beetle, very similar in shape to our own destructive apple weevil (*Anthonomus pomorum*, L.), which belongs to the same genus, but it is larger, measuring nearly a quarter of an inch in length. The eggs are laid singly in the "squares" or buds, which afterwards fall, or else in the "bolls" or seed-pods, in one of which latter sometimes as many as twelve of the thick whitish grubs may be found. They do not attack the leaves.

The history of this insect is curiously like that of the Colorado potato beetle. In both cases insects previously only known to entomologists, and feeding in comparatively small numbers upon some wild plant (the original food-plant of the Boll-weevil has not yet been determined), have attacked a cultivated plant, and increased enormously with devastating effects, and spread over a large tract of country. One subject which demands immediate attention from Governments (apart from those of countries already infested) is the instant adoption of any precautionary measures which may be necessary to prevent the danger of the insect being carried from Texas or Mexico to other cotton-growing countries, such as Africa or India.

W. F. Kirby.

GEOLOGICAL STUDIES IN PERU.

The third number of the *Boletin del Cuerpo de Ingenieros de Minas del Peru* (Lima, 1903), by Francisco Alayza y Paz-Soldán, director of the survey, raises several matters of general interest to geologists. It deals with the districts of Moquegua and Tacna, including some striking volcanic country between the Andes and the coast. The terrific eruption of Huainaputina in 1600 has left its traces in immense deposits of scoriæ across the adjacent country;

Fig. 1.—Ground disturbed by subsidence, Pallata.

the crater of the mountain was completely blown away, and a barrier was formed by the ejected blocks, strong enough to convert the Tambo River for twenty-eight hours into a lake. Part of the devastation was due to the bursting of this barrier, and the phenomena of earthquake and explosion justify the ranking of this catastrophe among the greatest in the human period. Since 1600 the volcano has become completely extinct. Its northern neighbour, Ubinas, on the same line of activity, is, however, looked on with suspicion, and still emits vapours, accompanied by a continuous roaring. These emanations have kaolinised the felspars in the surrounding lavas, and have formed alums, anhydrite, and sulphur near the vent. Though the last eruption, about which little is recorded, took place in 1662, it was of cataclysmic magnitude, and the author points out that repetitions may reasonably be expected.

Disturbances of quite another nature are described from Pallata, where sudden fractures of the volcanic surface have occurred as recently as 1902, leading to both depression and elevation. These are traceable to the absorption of water by the underlying tuffs, much as, according to Arcidiacono, the "earthquake" of Nicosia in 1901 was caused by the swelling up of clays during a rainy season, beneath a series of Miocene sandstones. The four excellent illustrations make us desire more from this little known region of Peru. It is unnecessary to emphasise the importance of the volcanic chain in connection with the Pacific coast-line, and with the suggestion, made by Rey y Bassadre, of a companion chain opening along some hidden fissure out at sea.

G. A. J. C.

RELATION BETWEEN TEMPERATURE AND ELEVATION.

In a communication to the *Comptes rendus* of January last Prof. Teisserenc de Bort gave a condensed account of the research relating to the decrease of temperature with elevation in the region of Paris. This investigation is, perhaps, the most complete that has been undertaken, for the deductions are made from the discussion of an excellent series of 581 aërial soundings by means of *ballon-sonde* extending over five years. From so many observations the general conclusions are therefore of considerable weight, and the results of great importance. The author divides the observations into two groups, one (A) showing the results of 581 ascents, and the other (B) restricted to 141 ascents when the altitude attained fourteen kilometres. In the tabular statements which accompany the paper the temperature values are given for every 500 metres up to a height of 5000 metres, after which values for each kilometre rise are adopted; the results are also grouped to show the changes between the four seasons of the year. Two sets of values for the air temperature in degrees Centigrade are given here, namely, those obtained during summer and winter, the letters under each heading belonging to the groupings previously referred to:—

Altitude	Summer		Winter	
	A	B	A	B
Ground	+13·5	+13·0	+ 1·7	+ 1·9
500 m.	+13·9	+13·6	+ 1·1	+ 1·4
1,000	+11·8	+11·8	− 0·4	− 0·2
1,500	+ 9·2	+ 9·7	− 1·9	− 0·2
2,000	+ 6·8	+ 7·3	− 3·7	1·4
2,500	+ 3·3	+ 5·0	− 5·7	− 3·7
3,000	+ 1·7	+ 2·1	− 8·2	− 6·0
3,500	− 0·4	+ 0·2	−10·9	− 8·7
4,000	3·4	− 2·7	−13·6	−10·9
4,500	− 5·9	− 5·3	−16·7	−14·2
5,000	− 9·3	− 8·3	−19·8	−17·0
6,000	−15·3	−14·8	−26·4	−23·7
7,000	22·3	−21·7	−33·6	31·5
8,000	−29·9	−29·3	−40·8	−39·0
9,000	−37·9	−38·0	−47·4	−46·9
10,000	−45·2	−45·3	−52·9	−54·0
11,000	—	−50·3	—	−57·9
12,000	—	−52·7	—	−57·9
13,000	—	−51·5	—	−56·9
14,000	—	−51·3	—	55·5

The author refers in some detail to the peculiarities of the rate of decrease of the temperature, and indicates the "zone isotherme" previously noted by him, which lies at an altitude of about 11 kilometres, in which the temperature ceases to decrease, its altitude being the same for every month throughout the year.

THE RELATION OF MATHEMATICS TO ENGINEERING.[1]

We may sum up what seem to be the best ideals in secondary school mathematics as follows:—

These ideals come from the engineering professions. They insist upon quality rather than quantity. They insist that the problems shall be largely concrete and shall be worked out to an accurate numerical result. They insist

[1] Abridged from an address delivered by Prof. C. A. Waldo, as president of the section of mechanical science and engineering of the American Association, at the St. Louis meeting.

that the thought shall precede the form, that the symbol shall not conceal the thing symbolised. They insist that systematic and progressive problems based upon every-day experience and observation shall be, to a much greater extent, the materials of education. They demand that the several elementary mathematical subjects, from arithmetic to the calculus, shall develop side by side in the boy's mind. They demand that the mastery of these subjects shall be more the work of the judgment than of the memory. They demand that from first to last, at least during the secondary period, mathematical ability and the ability to think clearly, investigate closely and conclude correctly shall develop together, and to the extent that four well-spent years will on the average permit. Those who formulate these ideas contend that they lead to the correct mathematical training for all professions and all careers.

The proposition that mathematics is the very bone and sinew of an engineering course needs no discussion. It is everywhere conceded. The extent and nature of the mathematical element in the curriculum, however, are two decided fluents with curves of opposite slope. More mathematics but fewer kinds seems to be the tendency. The opinion appears to be gaining ground that the purely descriptive and highly specialised and professionalised elements in our technical courses should be reduced, while more subjects with a mathematical basis, with long unbroken continuity and bound together with a strong logical element should command the attention of the student to the end of his undergraduate period.

Upon the question as to what mathematical subjects shall the undergraduate courses include in our technical colleges, opinions are decidedly at variance. Upon the four ordinary elementary subjects the sentiment is practically unanimous, but these should be principally taught in the secondary schools. The practical people, however, are inclined to relegate analytic geometry and the calculus to the scrap pile. To such subjects as vectors, theory of functions, theory of groups, they allow no place whatever.

One cannot but feel that this verdict against analytic geometry and the elementary calculus—not to mention higher subjects—is a great pity. Especially does it seem true when we recall that instruction in these two lines forms the principal mathematical element of the second and third years of the ordinary technical course, and that the calculus itself is probably the most powerful and wonderful tool for investigation that the genius of man has ever contrived.

Why do practical men almost unanimously place calculus among the dispensable elements of a technical curriculum? The answer, of course, is very simple; they have never found any use for it, probably because they have never learned how to use it. Yet they dare not pronounce against it altogether. They know that Rankine and Maxwell were master mathematicians, and that through this mastery of the most powerful of tools they were able to do for terrestrial what Newton and Laplace did for celestial mechanics. In college the engineer has not learned to use the modern tool called the higher analysis; it remains to him as foreign currency. Out of college he has not time to learn its use.

The most effective teaching of the higher analysis will be possible only when reforms in mathematical instruction have permeated the principal secondary schools.

The teacher should be saturated with his subject. Not only should he be strong and apt on the formal side, but more important still, its inner meaning should be clear to him and its close relation to the phenomena of the objective and subjective life. Some contend that the only man to whom the mathematics of a technical college can be entrusted is an engineer. Does that make any difference? Rather are not these the essential questions? Does the man know his subject? In his teaching can he assemble from engineering and other records the material that will vitalise his work? Is he in sympathy with engineering essentials and ideals?

Throughout the college course the teaching should be mainly concrete. The problem, say from the physical sciences including engineering, should first be presented concretely. It should then be stated in mathematical symbols. The operations performed upon the symbols should be accompanied by drawings or models, the final result reduced to numerical form, and then interpreted in language. Upon every problem the student must bring to bear the whole range of his acquired powers and be taught to select the shortest method within his ability.

In other words, all typical problems should receive a three-fold consideraton:—(*a*) its statement in words, and the statement in words of its solution when effected; (*b*) its graphical statement and solution, involving geometry and mechanical drawing with squared paper; (*c*) its analytic statement and solution, ending with a numerical result.

The purely formal should be presented as a necessity arising from the so-called practical, and in order that a body of knowledge and technical ability may be accumulated which will give the student easy control over the practical in whatever one of its various forms experience shows that it may arise.

The problems chosen should be progressive in character, and their mastery should amount to a complete laboratory course in all that part of the higher analysis in which it is desirable that the engineering student should be well versed.

The course should be lecture and seminarium and individual, more after the manner of the German Technische Hochschule. The text-book should become a book of reference. The instructor should know clearly and be able to state accurately the limitations of his methods, but abstruse discussions of obscure points should be postponed as long as a due regard for logical development will allow. Time is wasted in removing difficulties the existence and importance of which the student has not yet recognised.

These are some of the necessary extensions into college work of the reformation now urged upon the secondary schools, and though every one of them seems familiar enough when taken separately, all together their united application to the mathematical courses in our technical colleges amounts to a departure from our present traditional methods little short of revolutionary.

In recent years mathematical instruction in the United States has greatly improved in its thought content, but it has responded slowly and conservatively to modern methods. We are still more English than German. In the work of training a master of the physical sciences the text-book and the senseless repetition of words and formulas have been replaced by the lecture, the laboratory and the seminarium. Why should not mathematics, so intimately related to them, follow their lead and partake in the benefits of modern methods carried to their legitimate and logical completion?

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

HARVARD UNIVERSITY has, we learn from *Science*, received a gift of 50,000*l*. from Mr. David Sears, of Boston, a graduate of the class of 1847.

A COMMEMORATION day will be celebrated at Glasgow University on April 19, when an oration will be given by Sir William Ramsay on Joseph Black, who was lecturer on chemistry from 1756 to 1766 in the old college.

DR. HAROLD JACOBY, adjunct professor of astronomy at Columbia University, New York, has been promoted to a professorship. Prof. Jacoby will continue as acting director of the Columbia University Observatory during the absence of Prof. Rees on account of illness. Dr. C. L. Poor, formerly at the Johns Hopkins University, has also been appointed a professor of astronomy, and will be associated with Prof. Jacoby at Columbia.

THE governing body of the South-western Polytechnic, Chelsea, has unanimously appointed Mr. Sidney Skinner, of Christ's College, Cambridge, to the position of principal in succession to Mr. Herbert Tomlinson, F.R.S., who is retiring. Since 1888 Mr. Skinner has been attached to the teaching staff of the Cavendish Laboratory at Cambridge, and also has acted as lecturer and director of natural science studies at Clare College. Mr. Skinner will take up his duties at the polytechnic about the beginning of May next.

LORD CURZON'S scheme for the reform of Indian education, referred to last week (p. 476), has been received with approval in this country, especially in so far as it condemns the dominating influence of the examination system. The whole system of education is to be reorganised with the idea of coordinating all the forces and promoting action in rational directions. A Reuter message from Calcutta states that on Monday, March 21, the Universities Bill was passed by the Legislative Council after a second sitting lasting three days. In the course of a speech upon the objects of the Bill, Lord Curzon said that the university question was a most vital, tremendous, and sacred one, and would have a profound effect upon the future of the people.

A FREE public reference library, having distinctive characteristics, is in course of formation by the London County Council at the Horniman Museum, Forest Hill. The primary intention is to encourage the study of geology and the biological sciences—especially as represented in the Horniman Museum collections—by providing the best books on these subjects, more particularly the works of admitted authority which, by reason of cost and a relatively small demand, are not ordinarily found in libraries freely accessible to the general public.

IT has already been announced that the Committee of the Privy Council has agreed to recommend the scheme for the foundation of the University of Leeds on the understanding that a capital sum of at least 100,000*l.* be raised for university purposes. At a meeting of Leeds citizens held on Tuesday, it was stated that annual grants amounting to about 12,000*l.* have been promised from various public sources, but the power to utilise this additional income effectively will depend to a great extent on the raising of a sufficient capital sum to carry out the extensions. These extensions, with their equipment, will cost not less than 70,000*l.*, and an effort should be made to add at least 50,000*l.* to the endowment fund. Promises of nearly 40,000*l.* have been already received. Many of these are, however, conditional on 100,000*l.* at least being raised. The following resolution was unanimously adopted:—"That this meeting welcomes the foundation of a university upon the basis of the Yorkshire College, and expresses its earnest hope that such a capital sum will be obtained forthwith as will enable the university to carry out the important educational purposes for which it will be established."

IN a lecture delivered at Owens College, Manchester, on March 15, Mr. Brudenell Carter laid down the general proposition that if ever the art of education is placed upon a scientific basis, it will properly be regarded as a department of applied physiology. Referring to the educators of to-day, Mr. Carter said that their art is purely empirical, and they work upon a basis of limited personal experience uncontrolled by scientific knowledge or by any general and admitted principles of action. They differ widely from one another on questions which should be placed beyond the reach of doubt, and there is no general recognition of any authority to which they can appeal. In these circumstances it is surely time for physiology to emerge from her seclusion and to apply herself to a systematic investigation into that which is fitting or necessary to be done. The physiologist who desires to elucidate educational problems, the lecturer remarked, is confronted by three of primary importance. The first is to ascertain the conditions which determine the greater or less strength of the brain as a whole; the second, assuming every healthy child to be adequately furnished at birth with brain cells in a rudimentary state, is to ascertain what are the conditions which call those cells into activity or which condemn them to remain only partially developed; and the third is to ascertain what circumstances determine development in one direction rather than in another.

THE Goldsmiths' Company has decided to give up the Goldsmiths' Institute at New Cross on September 29 next, and the staff have received notice that their engagements will be terminated on that date. The reasons for this decision of the company are given in a letter addressed to all members of the staff. The letter states that the funds necessary for the site, buildings, equipment, and maintenance of the institute have been provided out of the company's private resources, and as a consequence the institute has, unlike the other polytechnic institutions in the metropolis, occupied an entirely independent position; but this independence cannot be maintained in the future, for the Education Act has constituted a single authority for the whole of London education, and this body will have supreme power over all schools and institutions maintained by public money. It is desirable that voluntary institutions such as the Goldsmiths' Institute should be coordinated with other metropolitan educational institutions. It has of late been increasingly difficult for the Goldsmiths' Institute to hold its own, and to keep pace with other institutions financed by means of charitable and public funds, and this difficulty will be greatly accentuated in the future, having regard to the fact that the cost of secondary, as well as that of primary, education will be paid for out of the rates. For these and similar reasons the Company has decided to discontinue the institute.

SIR DONALD CURRIE has given 80,000*l.* for the erection of a school of advanced medical studies in connection with University College, and in this way has removed the only impediment to the complete incorporation of University College with the University of London. In a letter to Lord Rosebery, the Chancellor of London University, and Lord Reay, president of University College, making known his generous intention, Sir Donald Currie says he gives the sum necessary for the purpose knowing that when the incorporation has been accomplished, University College "will be maintained as a centre of wide academic culture, and that anatomy, physiology (including pharmacology), biology, chemistry, physics, &c., which are subjects of preliminary and intermediate medical study, will still continue to be taught there." In addition, Sir Donald Currie has given a further 20,000*l.* to provide a suitable nurses' home and accommodation for medical students, and his daughters have given 2500*l.* to furnish the home and to secure a library for it. In thanking Sir Donald Currie for his magnificent gift, Lord Rosebery and Lord Reay point out that the donation will assist the university and the college to carry out the scheme of incorporation which it is believed will be of the highest importance to the future of university education in London, and will direct the course of the university authorities along the line of development by which London may be made the seat of a university worthy of the metropolis of the Empire.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, March 3.—"The Optical Properties of Vitreous Silica." By J. W. **Gifford** and W. A. **Shenstone**, F.R.S.

The authors have made a number of measurements of the optical constants of vitreous silica, which substance, owing to its uniformity of composition, to its great transparency to ultra-violet radiations, and to its not being doubly refracting like quartz, seems likely before long to play an important part in optical work.

At present it is rather costly, but this difficulty is rapidly being overcome.

The prisms used by the authors were made by processes already described in our columns (NATURE, vol. lxii. p. 20, and vol. lxiv. p. 45). The uniformity of the new glass was tested by building up a compound prism from four slabs of silica, prepared separately, by cementing them one above another and then cutting a prism from the mass. This was compared with a similar prism made from four pieces of borosilicate glass (Schott's No. 0·364), all from the same melting, and was found to be distinctly superior in its performance to the latter.

The paper includes a curve for a thin doublet of fluorite achromatised with vitreous silica which shows that the focal length of the combination is almost independent of the wave-length, also a list of focal lengths for a lens of fluorite and vitreous silica, and a table of the partial and proportional dispersions of fluorite, vitreous silica and quartz.

The following refractive indices for vitreous silica are recorded in the paper :—

Wave-length	Index	Wave-length	Index
7950 (Rb)	1·453398	2748·68 (Cd)...	1·496131
A′ 7682·45 (K_α)	1·4538915	2573·12 ,, ...	1·503707
B′ 7065·59 (He)[1]	1·455180	2445·86 (Ag)	1·51096
C 6563·04 (H_α)...	1·4564147	2312·95 (Cd)	1·519373
D 5893·17 (Na)...	1·4584772	2265·13 ,, ...	1·523053
A 5607·1 (Pb)...	1·459507	2194·4 ,, ...	1·529103
E 5270·11 (Fe)...	1·4609945	2144·45 ,,[2] ...	1·533898
F 4861·49 (H_β)...	1·463165	2098·8 (Zn) .	1·538547
G′ 4340·66 (H_γ)...	1·4668500	2062·0 ,, ..	1·54271
H′ 3961·68 (Al)...	1·470542	2024·2 ,,[3] ..	1·54721
3610·66 (Cd)...	1·475112	1988·1 (Al) ...	1·551990
3302·85 (Zn)...	1·480610	1933·5 ,,[4] ...	1·55998
3034·21 (Sn)...	1·486881	1852·2 ,, ...	1·5743

Temperature Refraction coefficient for D for 1° C. – 0·00000346.

Note.—The number of figures in each index indicate the estimated freedom from errors of observation. The following interpolated indices (see focal curves) are in all probability more correct for the wave-lengths given:—

[1] 1·45516. [2] 1·53392. [3] 1·54728. [4] 1·56003.

Royal Astronomical Society, March 11.—Prof. H. H. Turner, president, in the chair.—The secretary gave a short account of a paper by Prof. Ernest W. **Brown** on the degree of accuracy of the new lunar theory, and on the final values of the mean motions of the perigee and node.—An account was also given of a paper by Mr. E. **Nevill** on the comparison between the purely theoretical and observed places of the moon, containing some criticisms of Mr. Cowell's note on the errors of the moon's tabular longitude published in the November number of the *Monthly Notices*.—Prof. **Turner** read a note on the instrumental errors affecting observations of the moon, in which he concluded that it seems probable that meridian instruments may give very different values for the parallactic inequality, and that the results derived by Mr. Cowell, especially that for the sun's parallax, must, until these instrumental errors have been more fully discussed, be received with caution.—Mr. **Cowell** read a paper on methods of analysis of the moon's errors, with some results.—The **Astronomer Royal** described the volume of the Greenwich Astrographic Catalogue, now in course of publication. The determination of positions and magnitudes of the stars was discussed, and the probable errors of photographic star places compared with those obtained from meridian observations.—Mr. **Furner** read a paper by Mr. **Storey** and himself on the absolute proper motions of certain double stars showing large relative motion.—Mr. **Maunder** read a paper by Mrs. **Maunder** and himself on the date of the passage of the vernal equinox from Taurus into Aries, illustrated by photographs of Babylonian tablets.—Other papers were taken as read.

Royal Meteorological Society, March 16.—Captain D. Wilson-Barker, president, in the chair.—Mr. Richard H. **Curtis** delivered a lecture on water-vapour.

PARIS.

Academy of Sciences, March 14.—M. Mascart in the chair.—On the solubility of silicon in zinc and lead: Henri **Moissan** and F. **Siemens.** Silicon commences to dissolve in zinc at a temperature of about 550° C., and at 850° C. the molten metal contains about 1·62 per cent. of silicon. As the temperature increases the solubility increases very rapidly. Silicon commences to dissolve in lead at a much higher temperature than in zinc, about 1100° C., and only 0·79 per cent. is dissolved at the boiling point of the lead. The results are expressed in the form of curves.—On a new mode of formation of calcium carbide: Henri **Moissan.** By the electrolysis of fused calcium chloride, or better, of a mixture of fused calcium fluoride and chloride, in a graphite crucible, the metallic calcium formed combines partially with the carbon, forming calcium carbide. The yield is poor, but the observation is interesting, since the carbide is formed in this reaction at a temperature as low as 650° C.—Observations concerning the mode of fructification of the Cycadofilicineæ: R. **Zeiller.** A discussion of the bearing of some recent work by R. Kidston on the views of M. Grand'Eury. It is pointed out that the gymnosperms held a much more important place in the formation of the Coal-measures than has hitherto been supposed.—The comparative actions of heat and the *n*-rays on phosphorescence: R. **Blondlot.** It is known that a rise of temperature increases the intensity of phosphorescence of a faintly luminous screen, but a comparison of this effect with that of the *n*-rays on a similar screen shows important differences. Thus, whilst the *n*-rays increase the quantity of light emitted normally by the screen, they diminish the amount emitted obliquely. The effect of heat, on the other hand, is to increase the light emitted in all directions. An experiment is described by means of which the two effects can be compared on the same screen.—On the paludian character of the plants which form combustible fossils of all ages: M. **Grand'Eury.**—Note by M. **Bertin** accompanying the presentation of an Italian marine atlas published by M. Corazzini.—On an experiment made by the Suez Company for the suppression of malaria by the destruction of mosquitoes: Prince **d'Arenberg.** By the adoption of the preventive measures indicated by Ross and Laveran the mosquitoes in the Ismailia district have been practically destroyed. As a consequence, a very marked diminution in the number of cases of malaria has resulted.—M. Volterra was elected a correspondant in the section of geometry in the place of M. Cremona, M. Brögger a correspondant in the section of mineralogy in the place of M. Carl von Zittel, and M. Flahault a correspondant in the section of botany in the place of M. Millardet.—On perfect ensembles and uniform functions: M. **Zoretti.**—On the optical measurement of the difference between two thicknesses: A. **Perot** and Ch. **Fabry.**—New laws relating to the anomalous propagation of light in optical instruments: G. **Sagnac.**—On the amount of energy set free in a receiving antenna at different distances: C. **Tissot.** By modifying the method described in a previous paper, the author has been able to obtain a bolometer giving a much higher sensitiveness as a detector of the Hertzian waves. A comparison of the energy received at different distances showed that this probably varies as the inverse square of the distance of the receiver from the sending station.—On the disappearance of the radio-activity induced by radium on solid bodies: P. **Curie** and J. **Danne.** The intensity of the induced radiation can be expressed as a function of the time as a difference of two exponentials. These results can be explained theoretically by adopting the views of Rutherford, who supposes that the emanation, acting on the solid walls, creates a radio-active substance which disappears according to a simple exponential law. In disappearing this gives rise to a new radio-active substance, also following a simple exponential law, with a different coefficient.—On the natural rotatory power of certain bodies for the *n*-rays: H. **Bagard.** The rotatory power of solutions of sugar, tartaric acid, and of turpentine for eight groups of *n*-rays has been examined, the rays being distinguished by their refractive indices through aluminium and by their wave-length (Blondlot). For turpentine and sugar, the rotations are in the same sense as with ordinary light, and are normal in that the rotation varies in the inverse sense with the wave-length. For tartaric acid, which produces a dextro-rotation with ordinary light, the rotation is to the left with the *n*-rays. The rotations observed with the latter are several hundred times greater than with ordinary light; thus a solution giving +4° 42′ in a column of 20 cm. length with ordinary light gave −138° with *n*-rays in a column only 0·055 cm. long. It was found that the rotations produced were proportional to the thickness of the solution within the limits of experimental error.—Bishop's circle for 1902–1904: F. A. **Forel.**—Simple demonstration of the phase rule: A. **Ponsot.**—On an apparatus designed to act as a regulator for a water pump: J. **Meunier.**—The action of carbonic acid upon solutions of sodium nitrite: C. **Marie** and R. **Marquis.** Fresh experiments are adduced in support of the view that nitrous acid is set free from nitrites by the

action of carbonic acid, in reply to the criticisms of M. L. Meunier.—On some derivatives of α-campholytic acid and of α-campholenic acid: G. **Blanc** and M. **Desfontaines.**—A method of preparation of aldehydes and the systematic degradation of acids: E. E. **Blaise.**—On a general method of synthesis of the aldehydes: F. **Bodroux** (see p. 406).—A method of estimating vegetable proteids: L. **Beulaygue.** On two new larval forms of Thrombidium, parasites of man: F. **Heim** and A. **Oudemans.** The names *T. striaticeps* and *T. periceps* are proposed for the new species, which are described in detail, with illustrations.—On some experiments carried out in the laboratory in the catacombs of the Natural History Museum: Armand **Viré.** A study of the modifications produced in animals kept in total darkness.—On a new Cerianthus: Louis **Roule.**—On the secretory mechanism producing pearls: Raphael **Dubois.** The formation of the pearl cannot be considered as due to a simple ordinary secretion, the organic skeleton and the calcium carbonate not being secreted by the same element.—On the distribution of the chemical elements in the earth and its possible relation with the atomic weights: L. **de Launay.** From the considerations adduced by the author it would appear that whilst the earth was still in a fluid state the elements already constituted arranged themselves at distances from the centre which were greater as the atomic weights were smaller, as if, in fact, the atoms, absolutely free from all chemical affinity at such high temperatures, had obeyed, in a fluid sphere in rotation, a central attraction combined with centrifugal force.—On a new variety of orthose: L. **Duparc.**—The generalisation, by means of the nerves, of the action of the *n*-rays applied to a point of the organism: Augustin **Charpentier.**—The insufficiency of development of toxic origin: MM. **Charrin** and **le Play.**—The action of formaldehyde on milk: A. **Trillat.** The casein of milk is rendered absolutely insoluble by the action of very small amounts of formaldehyde. At the same time the antiseptic is not fixed by the albumenoid, and is free to exert its well known injurious effects when taken into the digestive system. The effect of the addition of this antiseptic to milk is thus doubly injurious.—On the essence of *Artemisia herba alba*: E. **Grimal.**

GÖTTINGEN.

Royal Society of Sciences.—The *Nachrichten* (physico-mathematical section), part vi., 1903, contains the following memoirs communicated to the society:—

October 31, 1903.—S. **Nakamura**: On the law of the velocity of light in tourmaline. R. A. **Houstoun**: On the action of a transitional stratum in total reflection.

November 28, 1903. G. **Herglotz**: Contribution to the theory of electrons.

December 12, 1903. H. **Gerdien**: Measurements of the electrical conductivity of free air during four balloon ascents.

The *Proceedings* of the society include a discourse, by Prof. Verworn, on natural science and cosmical theory; an address of congratulation on his jubilee to Dr. Lipschitz, of Bonn; and a note by F. Klein and K. Schwarzschild on a recently published portrait of Gauss at the age of twenty-six, which they decide to be in reality a portrait of Bessel.

DIARY OF SOCIETIES.

THURSDAY, MARCH 24.

ROYAL SOCIETY, at 4.30.—Croonian Lecture, on the Chemical Regulation of the Secretory Process: Prof. E. H. Starling, F.R.S., and Dr. W. M. Bayliss, F.R.S.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Direct Reading Measuring Instruments for Switchboard Use: K. Edgcumbe and F. Punga.

FRIDAY, MARCH 25.

ROYAL INSTITUTION, at 9.—Liquid Hydrogen Calorimetry: Prof. Dewar, F.R.S.

PHYSICAL SOCIETY, at 5.—Note on the Measurement of Small Inductances and Capacities and on a Standard of Small Inductance: Prof. J. A. Fleming, F.R.S.—A Hot-wire Ammeter for Measuring very small Alternating Currents: Prof. J. A. Fleming, F.R.S.—The Energy of Secondary Röntgen Radiation: C. G. Barkla.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Relative Advantages of Continuous and Alternating Current for Traction Purposes: J. M. Kennedy.

SATURDAY, MARCH 26.

ROYAL INSTITUTION, at 3.—The Life and Work of Stokes: Lord Rayleigh.

MONDAY, MARCH 28.

INSTITUTE OF ACTUARIES, at 5.—On the Valuation of Whole-life Industrial Assurances, with Allowance for Lapses: T. G. Ackland and J. Bacon.

TUESDAY, MARCH 29.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Lowering the Sill of the Ramsden Dock, Barrow-in-Furness: L. H. Savile.—Burntisland Harbour; Construction of the East Dock: R. Henderson.

CONTENTS.

THURSDAY, MARCH 31, 1904.

SCIENCE IN THE DAYS OF THE INQUISITION.

Giordano Bruno. By J. Lewis McIntyre, M.A., D.Sc. Pp. xvi+365. (London: Macmillan and Co., Ltd., 1903.) Price 10s. net.

Galileo: His Life and Work. By J. J. Fahie, M.I.E.E. Pp. xvi+451; with 27 illustrations. (London: John Murray, 1903.) Price 16s. net.

IT is a remarkably opportune coincidence that these two volumes, dealing as they do with the lives of two pioneers of science of the Italy of three hundred years ago, should have appeared almost simultaneously. Each book would be interesting in itself, but when taken together the lives of Bruno and Galileo afford us a striking insight into the state of scientific knowledge at the commencement of the seventeenth century, the great advances made by the philosopher and the physicist, each working on independent lines, the opposition which their labours aroused and the manner in which that opposition was affected by the character of the new ideas which they propounded

Whether we read the life of Bruno or of Galileo we find the same story told regarding the obstacles against which the two workers had to contend. These were (1) the widespread and deeply-rooted belief in Aristotle, (2) the prevailing opposition to the Copernican doctrine, and (3) the hostility of the Church of Rome towards any philosophy or doctrine which could be interpreted as coming into conflict with the teaching of the Bible, even though the exponent himself was at heart a zealous churchman.

The philosopher was necessarily brought into conflict with these influences at every step of his progress; not so the mathematician and physicist, who, so long as he came before the world as an inventor only, was standing on safe ground on which he could gain for himself an immense reputation. Accordingly, we find that while Bruno met with an early martyrdom, and his works sank into an oblivion from which they were not rescued until recently, Galileo's fame never suffered extinction, and the petty persecutions to which he was subjected are believed by the present writer of his life to have stopped short of actual personal torture.

Giordano Bruno was born at Nola, near Naples, in 1548, and at the age of fifteen entered the Dominican monastery at Naples. His advanced views soon brought him into trouble. In 1576 he left Naples, and, after sojourning three years in various parts of Italy, he arrived finally in Geneva, where he appears to have found the Calvinistic spirit of the times but little less narrow-minded and little more tolerant than the Catholicism which he had left behind in Italy. At Paris he met with an enthusiastic reception, gaining the support and admiration of King Henry III. Here he brought out his works "De Umbris," "Ars Memoriæ," "Cantus Circæus," "De Compendiosa Architecturâ," and his comedy, "Il Candelaio"; moreover, he was appointed to a university readership.

Not contented, however, he migrated to England and tried to establish a footing in Oxford, where he found little encouragement from a University in which implicit belief in the teachings of Aristotle was enforced by fines and penalties. His career was cut short by his success in "flooring" his opponent in a controversy. We note among many other interesting points that "what Bruno condemned in Oxford was the undue attention it gave to language and words, to the ability to speak in Ciceronian Latin, and in eloquent phrase, neglecting the realities of which the words were signs." In London the French Ambassador, Mauvissière, gave him a home, and he became acquainted with Sidney, Greville and other distinguished men. "No fewer than seven works from Bruno's facile pen were published in England." His experiences of English life in the Elizabethan times are interesting reading, but the English attitude of indifference to his teachings appears to have been highly irritating to a man of his disposition. At Wittenberg (1586–1588) he lectured to a sympathetic and appreciative university, and published a number of important books; as his biographer remarks, it was the last or nearly last spell of happiness that life had in store for him. At Helmstadt he was less fortunate, being excommunicated by the pastor Boethus. In 1590 he left for Frankfort, where he superintended the printing of his two great works "De Minimo" and "De Immenso."

Bruno's desire to be received back into his church probably formed one of his motives for accepting an invitation from one Mocenigo, of Venice, which proved to be his death-trap. A few months later he was denounced to the Inquisition, his case came before a tribunal, and he was sent to Rome, where, after a period of incarceration of about seven years, he was burnt as a heretic.

Of Bruno's philosophy we can only touch on a few points. He believed in an infinite deity and an infinity of worlds, his argument in favour of the latter doctrine being based on the perfection of the universe. There is room in the universe for an infinity of worlds, Bruno would contend, and a universe containing them must be more perfect than one without them, therefore we cannot believe in Divine perfection without admitting their existence. Of the "coincidence of contraries," now better understood to mathematicians as the "change of sign in passing through infinity, Bruno gives some illustrations which nowadays appear curious. For example, the coincidence of infinitely quick and infinitely slow motions is deduced from the fact that a body moving infinitely quickly in an orbit is at every instant at every point of the orbit and, "therefore, it stands still" (p. 179). His notion of matter as atomic (p. 241) led Bruno in "De Minimis" to formulate a geometry, offered as a simplification of Euclid, of which it is difficult to judge by existing standards. In regard to rectifying the circle through the ultimate coincidence of arc and chord, he agreed fairly well with modern theory, but he did not admit that a figure of one shape could ever be equal to a figure of another shape except approximately. An angle, though it could be multiplied indefinitely, could

only be divided into two equal parts; a circle had not an infinite number of radii, for from the centre only six lines could be drawn; a line could not always be bisected, for it might contain an odd number of atoms, and geometrical bisection was at best an approximation.

In his views on the value of riches, on progress, peace, happiness and such matters there is little to which objection could be raised nowadays. He appears to have believed in the transmigration of souls. In other matters of religion he arrived at views not differing much from those of a thinking man of the present age. He approved of religious worship as appealing to a class of intellect to which a purely philosophical religion would be incomprehensible.

Against the philosophers who, in the words of Socrates, "think they are wise when they are not," Bruno casts many a dash of sarcasm. "Many of the Peripatetics," he says in the *Cena*, "grow angry and flush and quarrel about Aristotle, yet do not understand even the titles of his books" (see p. 122). Does not this represent the position of the average present-day politician in regard to the Fiscal Question?

Bruno's philosophy was so far in advance of the narrow views of his time that he could not fail to make enemies. His endeavour to influence men for the better brought on him a fate which others had shared before him, and his name was quickly forgotten, not to be restored until nearly two centuries later.

The discoveries of Galileo have been brought more conspicuously before the world than the philosophy of Bruno, and their study presents little difficulty to the least advanced student of physics; nevertheless, there is much for everyone to learn from a perusal of this excellent biography. His discovery of the pendulum, whether from observations of the famous "Lampa di Galileo" at Pisa or otherwise, his restatement of the principle of Archimedes, his claims to be regarded as the inventor of the telescope, his discoveries of Jupiter's satellites, and of the appendages of Saturn, recognised as a ring forty-six years later by Huyghens, his observations of the crescent form of Venus, of the mountains of the moon, and of sun-spots, his attempts to solve the problem of longitude at sea by means of Jupiter's satellites, his investigations on floating bodies, and on uniformly accelerated motion, his discovery of the librations of the moon, his geometrical and military compass, all these and many other results of his genius are well and faithfully described.

In regard to the telescope we infer that, although the inverting telescope had been previously arrived at by accident by Dutch opticians, Galileo's erecting telescope with concave eyepiece embodied a different principle, but the biographer might have made this point clearer.

Of the difficulties against which Galileo had to contend much is said. His futile early attempts to obtain a chair of mathematics met at last with success at Pisa when he was only twenty-five, but his salary there was but 13*l*. per annum. Moreover, his refusal to adopt blindly the doctrines of Aristotle brought him into conflict with the University authorities, who showed their animosity against him by fining him for loss of lectures and by the countless little persecutions which the dons of unenlightened universities have from the earliest times brought to bear against men of independent reasoning power. The same hostility against Galileo was maintained by Pisa up to the end.

His happiest years were spent as professor at Padua, where students from all parts of the world flocked to hear his lectures and to receive private tuition from him. His classes overflowed the great hall of the university, and he even had to lecture in the open air. His discoveries attracted the admiration and esteem of the great potentates of the age, and his telescopes were eagerly sought for. His very success was indirectly the cause of his later troubles. That there is no rest but the grave for the pilgrim of science is well illustrated by his experience. For though his public duties only occupied him for sixty half-hours in the year (p. 118) his time was so taken up with private pupils that he gladly accepted an offer from his friend and old pupil, Cosimo II., Grand Duke of Tuscany, of a permanent endowment for research under the title of First Mathematician and Philosopher.

So long as he was under the Venetian Republic Galileo breathed in a free atmosphere. A comparison with Bruno's unfortunate experience in no way contradicts this view. Galileo was only appointed at Padua in September, 1592, about two months after the Venetian tribunal had concluded its sittings on Bruno, and it further appears that the State offered considerable resistance to Bruno's extradition, and only yielded to Papal pressure after it had been pointed out that Bruno was not a Venetian subject, and further that he was the subject of charges instituted previously in Naples and Rome. It was not till eighteen years later that Galileo left Padua for Florence, where his real troubles began. The discoveries of his telescope excited the hostility of the Aristotelian faction, and they supported the Copernican doctrine to such an extent as to bring him under the ban of the Romish Church. He was denounced to the Inquisition in 1612, but it was not until 1633 that proceedings were taken which resulted in the philosopher of seventy years being bound by oath to abjure the Copernican doctrine and being treated as a prisoner for the last nine years of his life. During that time, in his exile at Siena and Arcetri, his interest in science never waned, despite his infirmities, and he devoted his attention to dynamical problems on which he was still at liberty to express opinions. That Galileo discovered the principle of virtual velocities is a fact that may come as news to some of us.

In all the proceedings against Galileo his old *Alma mater* and enemy, Pisa, figures prominently. Of the obstinate spirit of the Aristotelians we have instances in Galileo's early experiments in dropping falling bodies from the Leaning Tower.

"With the sound of the simultaneously fallen weights ringing in their ears they still persisted that the 10lb. weight would reach the ground in $\frac{1}{10}$ of the time taken

by one of 1lb., because they were able to quote chapter and verse in which Aristotle assured them that such is the fact."

Others later on positively refused to look through his telescopes or to test his experiments on floating bodies.

The connection between music and mathematics was maintained in Galileo's case. He played on the lute and his father was a well-known authority on music.

Of the books themselves we can speak in the highest terms. Dr. McIntyre has evidently made an exhaustive study of recent editions of Bruno's works. His is the only English work dealing completely with Bruno's life and philosophy, and it is illustrated by a frontispiece of the statue erected in 1889 on the site on which Bruno was burnt. Mr. Fahie has been fortunate to secure the assistance of Prof. Antonio Favaro, himself the author of a monumental collection of Galileo's works. Every minute point, such as the familiar "Eppur si muove" anecdote is examined critically and the book is beautifully illustrated.

Let us not close these volumes without comparing the positions of scientific workers three hundred years ago and at the present time. The comparison brings little credit to our nation. Science teachers have quite recently been deprived of their posts, and their careers have been ruined by inquisitions. The attitude of the peripatetics towards experimental science finds its counterpart in the attitude of the modern "practical man" towards all pure science above B.Sc. standard. As for the hostility of Pisa towards Galileo, it has been pointed out elsewhere that workers at the two older English Universities have, in several cases, had to contend against similar and equally persistent opposition on the part of their *Alma mater* quite recently. It is true that men are no longer imprisoned, tortured, or burnt on account of their convictions. But, on the other hand, philosophers and mathematicians to grand dukes have ceased to exist. G. H. BRYAN.

A MONOGRAPH ON IMPORTED PARROTS.

Parrakeets. A Handbook to the Imported Species. By David Seth-Smith, M.B.O.U., F.Z.S. Pp. xix + 281; with 20 coloured plates and other illustrations. (London: R. H. Porter, 1903.) Price 40s. net.

MR. SETH-SMITH'S valuable monograph of the imported species of parrakeets is now complete, and forms a handsome, well-proportioned volume. Scientifically speaking, there is no distinction between a "parrot" and a "parrakeet," the latter word being merely a popular term used for the smaller parrots. It cannot be applied to any particular family, or to those species with long or short tails. The title of this work must therefore be interpreted in the sense in which it is generally used by aviculturists. The work treats of about 130 species belonging to the families Loriidæ, Cacatuidæ, and Psittacidæ (subfamilies Nasiterninæ, Conurinæ, Palæornithinæ, and Platycercinæ). No less than thirty-three species are represented on the beautifully executed coloured plates, and there are more than a score of illustrations in the text, chiefly illustrating the nesting and other habits. Moreover, the author has been careful to indicate the work or works in which a coloured illustration of those species not figured by him may be found. Full and most useful directions as to feeding and managing the different species are given, as well as for breeding those species which have reared, or are likely to rear, their young with us. It is also pointed out which species are most suitable for large aviaries, and which are more adapted for smaller cages. The whole book throughout is most readable and instructive. For as well as all worth reproduction which has been written about the different species in captivity, the author has collected from the folios of Gould, Mr. A. J. Campbell's "Nests and Eggs of Australian Birds," Dr. Mivart's "Monograph of the Loriidæ," and many other works a great deal that has been written about the life-history and habits of the birds in a wild state, so that his work forms an excellent history of these beautiful birds, and is alike interesting to the field naturalist and the aviculturist.

Turning over these interesting pages we notice especially the lorikeets or brush-tongued parrots, some of the most gorgeous of the tribe; the familiar cockatiel, which, with the exception of the budgerigar, is the commonest Australian species with English bird-keepers, breeding regularly in captivity; and the numerous race of the American conures. This group contains two species of especial interest, viz. the Carolina conure and the grey-breasted parrakeet. The former is the only North American parrot, and although once so abundant, seems likely to share the fate of the passenger pigeon. The latter, belonging to a genus containing but two known species, is one of the most interesting in the whole parrot family from the fact that these are the only nest-building parrots known, with the exception of the love-birds (Agapornis), which line their nest-hole with the pliant pieces of bark from green twigs, and may therefore be termed nest-building parrots. The present species, however, builds a large nest of sticks among the branches of tall trees, which no other parrots, so far as is known, ever do. It is gregarious, always living in flocks, and the nests, which perhaps at first are single and inhabited by a single pair of birds, are gradually added to until they become of enormous size. There is a porch to each chamber, and the present writer has often seen the black beady eyes of these little parrots peeping out as he passed under trees bearing these wonderful nests.

Then we come to the large genus Palæornis, to which belong parrots that have been known to civilisation from a remote period, *e.g.* the blossom-headed parrakeet, believed to have been described in the fifth century B.C. The restricted genus Polytelis includes the beautiful parrakeet known to Australians as the "green leek." The love-birds are remarkable, as before mentioned, for their nest-building habits, and those gorgeous little birds, the hanging parrakeets, for their curious habit of suspending themselves head downwards when sleeping. Among those species the beauty of which singles them out among a beautiful host, we have the broad-tailed parrakeets, of which the Rosella is the best known; the rarely imported

Alexandra parrakeet, discovered during the Stuart Expedition into central Australia in 1862; the paradise parrakeet, classed with the golden-shouldered parrakeet as the most lovely of all the Australian parrakeets; and the splendid parrakeet the wonderful colours of which, as well as those of the species last mentioned, are displayed on two of the plates.

It has been the aim of the author to make the present book a complete monograph of the imported species of parrakeets. New species may be expected to arrive from time to time. For instance, when the first part of the work was issued no living specimen of the varied lorikeet (*Ptilosclera versicolor*) had ever been known in this country, but a few months later a few pairs reached London, and this species has accordingly been included (with a coloured plate) in the appendix, in which additional information respecting several other parrakeets is to be found. O. V. A.

MULTIPLICATION TABLE.

Table of Multiplication, Division and Proportion for the Ready Calculation of Quantities and Costs, Estimates, Invoice Prices, Interests and Discounts, Weights and Strengths, Wages and Wage Premiums. By Robert H. Smith, M.I.M.E., &c. (Westminster: Archibald Constable and Co., Ltd., 1903.) Price 6*s.* net.

THIS consists simply of a gigantic multiplication table for every figure up to 100 times 160, there being 100 horizontal lines of products arranged in 160 vertical columns on a sheet 5 feet long and $11\frac{1}{2}$ inches wide. The sheet is mounted like a map upon canvas, so as to open at any part of the length and exhibit two pages, each page containing 10 vertical columns indexed right and left with every 10th number up to 100. To guide the eye wider spacing is provided at every fifth line and column, and still wider at every tenth, as in logarithm tables. The index numbers are equivalent to a repetition of the first column on every page, so that any line up to the 100th can at once be found. As in any other multiplication table, the figure found at any place is the product of the first figure on the line and the top figure of the column on which it is found.

On the back of the sheet are a corresponding series of pages on which Prof. Smith has explained how the table may be used for all the purposes described in the title.

If two numbers have to be multiplied together the product can, of course, be read directly if they do not exceed 100 and 160, but if that was all the table was for, even though it is well arranged, it would hardly be worth getting out of its place. If only one of the figures exceeds these by not more than two digits, it may be broken up into two parts, *e.g.* 3781 into 3700 and 81, and the two partial products read, preferably in a single column when that is possible, and mentally added. If both factors exceed these amounts then four partial products have to be found, and two columns must be employed, which may be on different pages. This necessitates writing down the four partial products of probably four digits each, and taking care that the units place is properly placed in each. Then on adding, the product is found exact, of course to the last figure. It is not worth while in this notice to refer to rules or practice as to placing the decimal point if the factors contain decimal figures.

Division, of course, is performed by finding the quotient in the body of the table on the line or column of which the first figure is the deviser. Then the quotient will be the first figure of the column or line. This is only possible when the dividend is an exact product of two numbers not exceeding 100 and 160. Of course, in practice it never is, and then interpolation is necessary. Prof. Smith gives two methods. Where, however, both the diviser and quotient exceed 100 and 160 the double interpolation necessary seems to the writer to involve so much trouble, and to provide such opportunity for mistakes, that he would prefer to perform the operation with a pencil and paper in the usual way of the school if slide rules, logarithm tables, or calculating machines were not sufficient or available.

Simple proportion can, of course, be performed where the four quantities are all actually existing in the table by direct inspection, but again, in practice they never would be, and interpolation, either single or double, would be necessary.

The other processes described in the title which involve one or other of these operations are explained in the text on the back. It might very well be that for certain classes of calculation or of office work where the computer or clerk had the same kind of thing to do indefinitely, the table would afford the readiest means of finding an exact result, but for general use by people who could not for want of practice be quite adept, it is a question whether the constantly recurring interpolation complication would not give more trouble than direct arithmetic, besides leading to endless mistakes. C. V. B.

THE ZOOLOGICAL RECORD FOR 1902.

The Zoological Record, vol. xxxix., relating chiefly to the Year 1902. Edited by D. Sharp. (London: Zoological Society, 1903.)

ALTHOUGH on the title-page this volume, which slightly exceeds its predecessor in bulk, bears the date 1903, as a matter of fact it was not in the hands of the public until the beginning of the present year. This slight delay, as the editor informs us, is more than accounted for by certain unexpected changes in the staff of recorders, notably the loss of the services of Prof. J. A. Thomson, who has felt himself compelled to relinquish the compilation of that very important section of the undertaking entitled "General Subjects." His place, apparently at short notice, has been taken by the editor, who, in addition, is responsible for the insects, as well as for the general supervision of the whole text, and must therefore have had very hard work to complete his task so nearly within the appointed time-limit. The other contributors the

loss of whose cooperation the editor has to deplore are Prof. Herdman and Mr. W. A. Brown.

In these circumstances, we have to offer special congratulations to Dr. Sharp on the appearance of this volume. We may at the same time take the opportunity of mentioning our satisfaction at the decision of the council of the Zoological Society to continue, at all events for the present, the publication of this invaluable record. Without in any way disparaging the "International Catalogue of Scientific Literature," it is quite certain that, in present circumstances, the zoological portion could not be issued with that promptness which renders the "Record" before us so invaluable to working naturalists.

Since all the contributors are specialists, thoroughly acquainted with their respective subjects, there is little or nothing to criticise in the *technique* of their work, and the present volume seems remarkably free from typographical errors. As usual, some of the recorders treat their subject, both in the way of introduction and in the class of papers quoted, at much greater length than others. In some sections—the mammals, for example—it appears to be the recorder's custom to exclude papers which do not contain absolutely new matter, and also those in which there is merely more or less incidental allusion to the particular subject, or summaries of previous work. In other sections—like the one on echinoderms—precisely the opposite course is followed, papers containing even the most remote and unimportant references to the subject being catalogued. Consequently, some of the pages in the section last cited look more like a geological than a zoological record.

It is not, of course, for us to decide which course is preferable. If, however, the more comprehensive plan is necessary in one section, it is apparently required in all, and *vice versâ*. The universal adoption of the fuller plan would largely increase the bulk of the annual volume, while if the system of elimination were followed throughout, its size would be proportionately reduced.

As an instance of our meaning, we may note that some writers quote the articles on their respective subjects from the volumes of the "Victoria County History," while by others they are omitted. Again, in one section (Echinoderms) we find the "Guide to the Dublin Museum" entered, which is surely unnecessary. In the same record also occurs Prof. Sollas's paper on the method of investigating the structure of fossil animals by means of sections, a paper which should have appeared only in "General Subjects," where it is conspicuous by its absence.

How absolutely essential to zoological workers—if they are to avoid using preoccupied names—is the prompt appearance of the "Record" may be inferred from the long list of new generic and subgeneric terms at the end of the present volume, which runs to 18 pages, against 16 in its predecessor.

In conclusion, we may direct attention to the request that authors would send copies of their papers to the editor. Labour would thus be saved to the recorders, and the prompt insertion of papers would be secured.

R. L.

OUR BOOK SHELF.

Æther and Gravitation. By W. G. Hooper. Pp. xiv+358. (London: Chapman and Hall, Ltd., 1903.) Price 12*s.* 6*d.* net.

FROM a psychological point of view this treatise of 358 pages is very interesting. The author "has endeavoured to perfect a theory which will bring ætherial physics more into harmony with modern observation and experiments." He "has taken Newton's Rules of Philosophy as his guide in the making of the new theory, as he believes that if any man knew anything of the Rules of Philosophy, that man was Sir Isaac Newton."

These rules are:—

(1) "Simplicity of conception." "If there are apparently two causes to the same phenomenon, then the simpler cause is the true and correct one."

(2) "Agreement with experience, &c."

(3) "Satisfactorily accounting for and explaining all phenomena sought to be explained."

These rules are first applied to gravitation. "The Law" (of gravitation) "is not a simple law. It is compounded primarily of three parts. 1st, a primitive impulse; 2nd, a centripetal force; 3rd, a centrifugal force. To these must be added the three laws of motion."

No known medium has been found to be absolutely frictionless. "Accepting therefore experience as a guide we are compelled to come to the conclusion that there is no such thing in the Universe as a frictionless medium. Such a hypothesis is contrary to all laws and rules of Philosophy," "and therefore as either experience or a frictionless medium has to go, we will part with the frictionless medium." "With the present conception of a frictionless æther, however, it is philosophically impossible for the æther to exert force on any body that may exist in it. Because to the extent that it is frictionless, to that extent it ceases to possess mass. If it does possess mass, then it cannot be frictionless."

The next point dealt with is matter, which is thus defined:—"Matter is that which can be perceived by the senses, or is that which can be acted upon by motion, or which can exert motion."

Incidentally we learn that vortex atoms cannot be cut in two. "It will be found that when the knife is brought near to them they seem to recoil from the knife."

Chapter iv. is entitled "Æther is Matter." In this chapter we learn something of the constitution of atoms.

"If therefore it holds good in Philosophy that the small things are the index to the greater, then the converse holds good, that what is true of the large is true of the small, and that the laws governing the great also govern the small." "So that gathering up those chief properties of the earth to which I have already referred, and applying them to an ætherial atom, or any other atom if necessary, we arrive at the conclusion that an atom must be spherical in shape, must possess rotation, and must have an orbit, must possess polarity, and also be subject to the universal Law of Gravitation." "Further, if we are to be strictly correct, in our analogy between the earth and the ætherial atom, its polar diameter must be shorter than its equatorial diameter, as that is one of the facts observable regarding the shape of our earth."

Similar lines of argument are applied in succeeding chapters to heat, light, electricity, and the universe in general. The author has read many books. He has not always succeeded in understanding them.

W. M. H.

Highway Construction in Wisconsin. By E. R. Buckley, State Geologist of Missouri. Pp. xvi+339. (Published by the State at Madison, Wis., 1903.)

THIS book forms part of the Economic Series of works published by the State of Wisconsin, and is an evidence of the trouble that is taken in the United States to furnish the officers having charge of the various departments with the fullest information as to their work that is available.

It contains eight chapters, relating respectively to the classification of highways, and the agents that destroy pavements; materials used in improving highways; methods of constructing different kinds of pavements; drainage; pavements constructed in the larger cities; abrasion and cementation tests.

In the introduction the writer points out that a purchaser or seller who is separated from a railway station by ten miles of good roads is actually nearer his market than the person who is separated by five miles of unimproved roads. Good roads mean heavier loads, more rapid transit, and a longer life for vehicles and horses.

That such a work as that now under notice is urgently required in the State of Wisconsin may be inferred from a further statement made by the author, that a dog is able to draw a load to market in many European countries which a horse cannot draw in the United States, and that up to the present time highways in Wisconsin are simply narrow tracks connecting different parts of the country, the one idea of construction being to fill the gullies and level off the roadway with such material as might be closest at hand.

There is some useful information contained in the book as to the tests carried out by the State for ascertaining the relative wearing values of different kinds of stones used in road-making, from which a lesson might well be learnt by the county councils in this country as to the advantage to be gained by maintaining an establishment for supplying their road surveyors with trustworthy data of this character.

There is one kind of pavement in use in some of the cities that might with advantage be used in this country, that is, blocks made of asphalt and laid in the same way as granite pavings. This pavement is stated to be non-slippery, while at the same time it is noiseless and non-absorbent. The cost is about the same as sheet asphalt.

Practical Chemistry. Part ii. By William French, M.A., F.I.C., and T. H. Boardman, M.A. Pp. xiii+126. (London: Methuen and Co., 1904.) Price 1s. 6d.

THIS book contains a well arranged series of experiments of a kind suitable for young students who have already spent a fair amount of time at practical chemistry. The physical properties of gases, the laws of chemical combination, sulphur and its compounds, some nitrogen compounds, and carbon and its simpler compounds, are among the chief subjects included in the volume.

Marsh-Country Rambles. By Herbert W. Tompkins. Pp. xi+307. (London: Chatto and Windus, 1904.) Price 6s.

MR. TOMPKINS confines his rambles, with few exceptions, to the marshlands east of the road which leads from Prittlewell to Maldon and Colchester, and south of the road from Colchester to St. Osyth. He does not pretend to offer the reader detailed descriptions of villages and towns, but rather to provide an interesting narrative in which history and legend are incidentally touched upon. With the exception of a frontispiece the book is not illustrated.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Occurrence of Thorium in Ceylon.

THE Government of Ceylon determined last year to carry out, with the cooperation of the scientific and technical department of the Imperial Institute, a systematic survey of the economic minerals of Ceylon. Mr. A. K. Coomaraswamy and Mr. H. G. Parsons were selected to conduct the survey in Ceylon, and to dispatch specimens of the minerals found to the Imperial Institute for chemical examination and commercial valuation. Among the specimens thus received were those of a mineral existing in small black cubical crystals found in the refuse from gem washings near Balangoda, in the Sabaragamuwa Province, which had been identified by Mr. Holland, a resident in Ceylon, as probably uraninite or pitchblende. The same mineral has been since observed by Mr. Coomaraswamy in a vein of pegmatite at Gampola, in the Central Province of Ceylon.

The specific gravity of the mineral was found to be 9·32, and an analysis by Mr. G. S. Blake, of the scientific staff of the Imperial Institute, furnished the following results:—

		Per cent.
Thorium oxide	ThO_2	76·22
Cerium oxide	CeO_2	8·04
Lanthanum and didymium oxide	La_2O_3 Di_2O_3	
Zirconium oxide	ZrO_2	trace
Uranium oxide	UO_3	12·33
Ferric oxide	Fe_2O_3	0·35
Lead oxide	PbO	2·87
Silica	SiO_2	0·12
		99·93

The mineral is clearly not pitchblende, since the percentage of oxide of uranium is only about 12 per cent., whilst the principal constituent is oxide of thorium (thoria), which is present to the extent of more than 75 per cent., an amount far higher than that contained in any mineral hitherto examined. This mineral appears to be new, and I suggest for it the name of *thorianite*. Since it is radioactive, it will no doubt be found to be an important source of radium or radio-active earths, and will probably furnish helium, points which will be investigated as soon as more material has been obtained.

A second part of the same specimen furnished the following results on analysis:—

		Per cent
Thorium oxide	ThO_2	72·24
Cerium oxide	CeO_2	6·39
Lanthanum and didymium oxide	La_2O_3 Di_2O_3	0·51
Zirconium oxide	ZrO_2	3·68
Uranium oxide	UO_3	11·19
Ferric oxide	Fe_2O_3	1·92
Lead oxide	PbO	2·25
Silica	SiO_2	1·34
Insoluble residue		0·41
		99·93
Specific gravity		8·98

The two sets of analytical data prove that the material has essentially a uniform composition, the differences observed being apparently due to inclusions of zircon in the second portion analysed.

In the meantime Sir William Crookes has received a specimen of the supposed pitchblende from Ceylon, and has found it to be radio-active to about the same extent as Cornish pitchblende.

Sir William Crookes was good enough to give me a part of his specimen, which is being analysed.

The second mineral examined was found by Mr. Holland in the same gem washings at Balangoda, and was identified as probably monazite. This mineral was pale brown, and when fractured exhibited a purple brown interior with a

resinous lustre. The specific gravity was 4·98. An analysis by Mr. Blake furnished the following results :—

		Per cent.
Thorium oxide	ThO_2 ...	66·26
Cerium oxide (and Cerium earths) ...	CeO_2 ...	7·18
Zirconium oxide	ZrO_2 ...	2·23
Uranium oxide	UO_3 ...	0·46
Ferric oxide	Fe_2O_3 ...	1·71
Calcium oxide	CaO ...	0·35
Phosphoric oxide	P_2O_5 ...	1·20
Silica	SiO_2 ...	14·10
Water	H_2O ...	6·40
		99·89

This mineral is therefore thorite, consisting chiefly of thorium silicate. Both these minerals are under further investigation at the Imperial Institute. Careful explorations are now being made as to the extent of their occurrence in Ceylon.

It is obvious that apart from the scientific interest attaching to the determination of their composition, the discovery in Ceylon of two minerals rich in thoria, now so largely employed for the manufacture of incandescent gas mantles, may be of considerable commercial importance.

Imperial Institute, March 29. WYNDHAM DUNSTAN.

Ionisation of Air.

SOME experiments have been recently made at the Cavendish Laboratory which seem to throw light on the question of the "spontaneous" ionisation of air. The anticipation of a detailed report of these in a short summary of the results obtained may serve some useful purpose by preventing a waste of energy on the part of others who are engaged in investigating the same subject.

The experiments consist in the determination of the saturation current through rectangular vessels, lined with the metal under investigation, the volume of the vessels being capable of alteration by the motion parallel to itself of one of the sides of the vessel. On plotting a curve the ordinates of which are the saturations currents and the abscissæ the distance of the movable side from the side opposite to it, it becomes clear that there are two separate distinct kinds of radiation causing the ionisation of the gas :—(1) a radiation coming from the sides of the vessel which is completely absorbed by some 5 cm. of air, and which, therefore, when the volume is considerable, gives an ionisation proportional to the surface of the vessel; (2) a much more penetrating radiation, which at all volumes gives an ionisation proportional to the volume of the vessel. Further experiments were then made by surrounding the vessel with lead sheets about 3 cm. thick and repeating the determination of the variation of the ionisation with the volume. The lead screen diminished the ionisation; by this method it was possible to discover which part of the radiation suffered diminution.

Up to the present time four metals have been investigated, lead, aluminium, zinc and tin foil. Of these, in the absence of the screen, the first three gave approximately the same value for the penetrating radiation causing volume ionisation. The absorbable radiation causing surface ionisation was greater for the aluminium than for the zinc, and still greater for the lead. When the screen was applied the penetrating radiation was diminished to about two-fifths of its value for all three metals. In the lead and the aluminium the value of the surface ionisation remained unaltered by the screen, but in the zinc this was decreased, and fell to about three-fifths of its original magnitude.

The tin was quite peculiar in its behaviour. The normal volume ionisation was only about one-third of that in the other metals, and when the screen was applied both the surface and the volume ionisations fell in the same proportion to two-thirds of their former values.

It is pretty clear, therefore, that at least in the case of tin and zinc we have secondary radiation given off from the surfaces of those metals under the influence of penetrating radiation coming from outside.

Some numbers may be useful to give an idea of the respective magnitudes of the radiations mentioned. Taking an arbitrary unit, the values for the ionisation caused by one square centimetre of surface of the metals are as follows :—lead 38·6, tin 33, aluminium 10, zinc 7·9. On the same scale the values of the ionisations due to the penetrating radiation in 1 c.c. of air enclosed in a vessel of these metals is for lead, aluminium and zinc between 3·2 and 2·8; for tin it is 0·9.

It is probable that many of the discrepancies that have appeared between the results obtained by different physicists may be explicable by a difference in the metal of which their vessels were composed. For example, it is clear that it might be possible to detect the effect of a screen on a zinc vessel, while in a lead vessel the diminution of ionisation due to the same screen would be inappreciable; similarly, it would be possible to measure in a lead vessel effects due to the surface radiation which could not possibly be detected if zinc were substituted for the lead. Further experiments on different metals, and with other modifications, are in preparation, which it is hoped will throw more light on this interesting problem.

NORMAN N. CAMPBELL.

Trinity College, Cambridge, March 25.

Respiration in Frogs.

Is the buccal cavity of the frog a respiratory chamber? In a letter to NATURE, March 24, Mr. M. D. Hill accepts this conception of it, and yet the only evidence which can be offered in support of this view is the rich blood supply of its lining membrane. The lungs and skin, which are known to be respiratory surfaces, are supplied by a special circulation; the buccal cavity is neither more nor less supplied with blood than the other parts of the alimentary tract, which are certainly not respiratory.

The oscillatory movement of the frog's pharynx, which occurs when the lungs are filled and the opening to the larynx closed, is one of a number of points connected with the respiratory system which have not yet been satisfactorily explained. The other points are :—(1) the evolution of the reptilian method of respiration from the amphibian; (2) the meaning of the laryngeal and bronchial musculature found in amphibians, reptiles, birds and mammals; (3) the closure of the auditus laryngis of the amphibian during the respiratory phase; (4) the attachment of part of the transversalis and rectus abdominis to the pericardium and roots of the lungs; (5) the air in contact with the respiratory surface of the lungs is always very impure. All these points, with the exception of the last, find their explanation in the fact that the act of respiration in all forms of vertebrate life produces two effects within the lungs :—(1) air is drawn into the air spaces; (2) blood is drawn into the pulmonary capillaries. Further, the rate of flow in the pulmonary capillaries, which are situated in the septa between the air cells, is determined by the pressure within the air cells. The air within the lung is used as a brake for regulating the pulmonary flow of blood. That is to say, the act of respiration in reptiles, mammals and birds has two effects, one on the air and another on the blood within the lung. In amphibians these two effects are apparently obtained by separate means.

In the major movement of amphibian respiration the air is forced within the lungs by the muscles of the pharynx and expelled by the contraction of the muscles of the body wall. In both phases of that movement, which are for the renewal of air within the lung, the pulmonary circulation is retarded by the positive pressure of the breathed air. When the lungs are filled and the opening of the larynx closed, the minor movements set in. They vary in different genera of frogs, but taking the noisy frog (*Rana clamata*) as a type in which to observe these movements, it will be noticed that the body wall muscles, especially the transversalis, contract and rather expand the body at the same time as the larynx is drawn downwards. In all Amphibia the larynx, pharynx, and their muscles are so closely bound up with the lung that the pressure of the pulmonary air must be affected by their movement. In short, the oscillatory movements of the pharynx in the Amphibia (and also in turtles and tortoises) create a negative pressure within the amphibian lung, and thus regulate and accelerate the flow of blood through that organ. For that reason

the larynx is closed in the inspiratory phase, and parts of the transversalis and rectus abdominis are attached directly or indirectly to the pulmonary roots.

Thus parts of the muscles of the amphibian trunk become inspiratory in action, for they contract during the inspiratory phase and tend by their contraction to enlarge the pulmonary space. If, then, the larynx were to be opened in this phase, air would be drawn within the lungs (regulated in its rate of inflow by the laryngeal, tracheal and bronchial musculature), and a thoracic type of respiration would be thus evolved. Thus the minor movements which occur in amphibians when the lungs are filled with air are evidently the precursors of the normal respiratory movements of reptiles, birds and mammals.

One other point in connection with the respiration of the frog may be mentioned; it has not received the attention it deserves. The air which the frog breathes is a mixture of the air just expired with a fresh supply drawn within its mouth. Further, I believe it never empties its lungs completely in expiration. Thus the air within the lungs is always a highly impure air. That is also the case with the air within the pulmonary alveoli of mammals, birds and reptiles. The explanation I offer is that when air breathing vertebrates were evolved from water breathing forms, the oxygen of the atmosphere had to be diluted to a proportion more nearly corresponding with the amount held in water, to which the system of branchial breathing forms were adapted. A. Keith.

London Hospital Medical College, E.

Degradation of Elements.

A statement reported as having been made by Sir William Ramsay, that radium breaks down into helium, has been received with a chorus of wonder as something absolutely new. May I point out that in Nature, October 10, 1889, p. 584, you have something very similar, in an account of some observations on gases in sealed tubes, communicated by the late Prof. Piazzi-Smyth to the British Association in 1889.

The whole of the paper is astounding, stating as it does that many substances break down into hydrogen, but perhaps the most remarkable part is:—"Again, an iodine tube which had a comparatively large quantity of solid iodine granules introduced into, and sealed up in, its interior eleven years ago, and showed then a splendid spectrum of 148 measured iodine lines, extending discontinuously from red to violet, and had nothing else save these very faint, puny images of the three principal lines of hydrogen—this tube, in 1889, has not a single iodine line now left; but its spectrum, which is now brighter than ever, is composed of nothing but hydrogen lines, so that the once solid iodine granules would seem to be partly changed into hydrogen, and partly deposited on the inside of the tube as a yellow haze, besides leaving a trifle of loose dust."

When in 1894 I saw this quoted in Preston's "Theory of Heat," I thought it momentous, and wondered why it had not been followed up and more made.

Some to whom I have mentioned it consider that it comes in the same category as the alleged complete metalepsis of manganese acetate communicated by Wöhler to Liebig's *Annalen*, vol. xxxiii. p. 308. S. H. Woolhouse.

Parmiter's School, Victoria Park, N.E., March 14.

I think it was generally believed that Prof. Piazzi-Smyth's results were due to the iodine being absorbed by, and the hydrogen being evolved from, the electrodes. There are many other recorded transformations, among them Dr. Samuel Brown's conversion of carbon into boron (or *vice versâ*, I forget which). The difference between the more recent work and the earlier consists in the fact that the transformation of radium emanation into helium is accompanied by a great energy change, while we do not know that the former supposed transformations are.

Although in all probability the result would be negative, the re-investigation of the old recorded cases is not to be discouraged. William Ramsay.

University College, London.

Remarkable Destruction of Birds in Cardigan Bay.

The following incident, which has excited much interest here, seems to me to be of more than local interest, and to be worthy of record in the columns of Nature.

On Friday, March 18, many of my pupils in the Pwllheli County School, on returning from dinner at 2 p.m., informed me that "hundreds and thousands" of birds—starlings, thrushes, blackbirds, woodcock and snipe—had just been cast upon the shore at high tide.

Further, that, during the small hours of the morning, large numbers had fallen "dead beat" upon the deck of a vessel entering the harbour, and also that some had fallen, in a helpless and dying condition, among, and even upon the backs of, workmen employed at the granite quarries on the Gimblet Rock. At first I was naturally somewhat sceptical, but on inquiry in several quarters I found that my informants had correctly stated the case, and that large numbers of birds—all land-birds, be it noted—had been found all along the coast from a point some distance east of the town so far as Aberdaron, several miles to the west. The theories put forward to account for the occurrence were many and varied. Some held that electricity was to be held accountable—either the ordinary atmospheric sort or that uncanny variety manipulated by Mr. Marconi. Others suggested, in all seriousness, a special miraculous intervention of Providence, on the ground that the frost this year had not killed a sufficient number of the feathered tribe!

On the following day I visited the shore with the view of finding some clue to the mystery. I found enough to lead me to believe the following to be the simplest explanation. The warm weather and copious rains of the last few days must have melted large masses of snow on Snowdon and neighbouring ranges. This may have caused in some of the valleys opening out into Cardigan Bay a flood of sufficient magnitude to carry away bushes and trees on the banks of the swollen mountain torrents. Assuming this to have occurred during the night—moonless, starless and possibly foggy—it is conceivable that birds roosting in the branches would cling to them and be carried out to sea. At dawn, finding themselves literally and metaphorically "at sea," the birds would fly hither and thither, and finally sink exhausted. A strong easterly breeze then prevalent would account for the rest. There was, in my opinion, abundant evidence of a flood. In addition to the birds (thrushes, starlings and blackbirds, according to my personal observations) lying about three feet, vertically, above the ordinary high-water mark—the Friday mid-day tide being a spring tide—I found many twigs and a few good-sized branches of alder and willow, besides a branch of a pruned apple tree. Several onions and some cabbages were lying at the same level as the birds, together with a square wicker basket with rope handles. The latter probably indicate a flooded garden, which may enable us later to localise the flood.

The main difficulty to my mind lies in the failure of the birds to leave their drifting perch before getting out to sea. Perhaps some readers of Nature better acquainted with bird life than myself may be able to throw light on this remarkable occurrence.

C. W. Herbert Greaves.

The County School, Pwllheli, N. Wales, March 21.

Distribution of the Nightingale.

The fact that the distribution of the nightingale is restricted to the drier parts of these islands is well known, but the causes of this are obscure. If an excessive amount of rain be one of them, it is probable that last summer would have had the effect of reducing the number of young birds, and consequently of the immigrants of this spring. I should therefore be much obliged to any of your readers who live in a nightingale country if they will inform me towards May 1 whether they observe any difference in the number of these birds.

I may mention that the nuthatch, a bird which, though not altogether migratory, has a similar range (I have never met with it in North Wales, where I lived many years), has disappeared from here entirely this winter, though it was abundant in former winters. Alfred O. Walker.

Ulcombe, Maidstone, March 19.

THE NATURAL HISTORY OF VENEZUELA.[1]

WHY the title of this volume should be what it is is not apparent. We know of British, of French, and of Dutch Guiana, but the volume before us has to do with neither of these political areas, but is concerned solely with the central portion of Venezuela. The author gives an account of two journeys undertaken by him, from Trinidad as a starting point, up the Orinoco and some of its tributaries to within 5° of the Equator. It is the land of the fabled El Dorado, a land which excited the cupidity of the early adventurers of whom Raleigh was one, the home of alleged natives "whose heads do grow beneath their shoulders," as Shakespeare, copying Raleigh, asserted.

Humboldt and Bonpland dissipated many of the illusions relating to this country in the early part of the last century, and now we have, from the pen of Mr. André, a plain, matter-of-fact narrative which adds considerably to our knowledge of the country. The author is well known as a collector of birds, insects, orchids, and other objects of natural history, and the account that he gives of his expeditions is full of interest, replete with incident, but told with a modesty and straightforwardness which invite sympathy and beget confidence.

The district traversed is mainly one immense forest more or less impenetrable except along the river-banks, interspersed here and there with open savannahs, and varied with mountains of fantastic shape and surpassing grandeur. The natural resources of the country are great, but the political state is such as to obstruct all progress, while the interior is difficult of access and the climate deadly. The author was foiled in his attempt to ascend the Améha, but, from what he tells us of that mountain, its physical features would seem to be like those of Roraima.

He had repeated attacks of fever, but his direst misfortune was in the rapids of Arichi, where in a few short seconds the work of months was lost, and for weeks thereafter the party had to struggle on foot to reach that settlement (La Prision) which some of them were doomed never to see. The account of this disaster is told in the simplest and therefore most graphic manner.

But this story of hairbreadth escapes, though attractive to the general reader, is not what will appeal most strongly to the readers of NATURE. They will be interested in the numerous notices of birds, insects, mammals, and orchids which are scattered through the pages of the volume, and greatly add to its value. There are very interesting accounts of the gathering and harvesting of the tonka-bean, which forms one of the principal industries of the country, and of the collection of the balata and other caoutchouc containing products. Among the orchids, *Cattleya superba*, one of the most beautiful of a lovely genus, is the one most often mentioned. The flowers are some five inches across, rich rosy purple in colour, and very fragrant. Among other commercial products exported from Ciudad Bolivar are the feathers known in the trade as ospreys. The swamps bordering the rivers Apure and Arauca are the abode of numberless flocks of wild fowl, among which two varieties of egret are abundant.

"It is from these egrets that the feathers which form so expensive an article of commerce are obtained. The small egret (*Ardea candidissima*) produces the most valuable plumes; from the larger birds (*Ardea garzetta*) a coarser feather is obtained which is not so much appreciated, but the wily dealer can sort his plumes so as to introduce a fair proportion of the inferior article without danger of detection. Quite a number of birds have to be slaughtered to produce a pound of feathers, only a few drooping plumes from the backs of the birds being taken. The season for collecting extends through the months June, July and August; that is through the mating and breeding period. The egrets are wary birds and difficult of approach, except when they are nesting or rearing their young, and it is at this time that the collector obtains his feathers. The persistence with which the same localities are chosen by the birds for this purpose, year after year, is an instance of that extraordinary predilection on the part of many birds to repair to the spot where they themselves have been reared, for the purpose of nesting. These spots are called *garceros*, and as they are generally on private lands, the owners make quite an income by hiring out the privilege to kill egrets. As much as 2000 pesos, equal to 1000 dollars of United States money,

FIG. 1. Young of the Snowy Egret. (From "A Naturalist in the Guianas.")

[1] "A Naturalist in the Guianas." By Eugène André. Pp. xiv+310; with thirty-four illustrations and a map. (London: Smith, Elder and Co.) Price 14*s*. net.

have been paid for this privilege on a single *garcero* during one season. In spite of the slaughter of thousands of these birds, the *garceros* continue to be used by the egrets, but in ever diminishing numbers. The beauty of a few feathers on their backs will be the cause of their extinction. The love of adornment common to most animals is the source of their troubles. The graceful plumes which they doubtless admire in each other have appealed to the vanity of the most destructive of all animals. They are doomed because the women of civilised countries continue to have the same fondness for feathers and ornaments characteristic of savage tribes."

In concluding this notice of a very interesting book, we have only to add that there are numerous illustrations—of which, through the courtesy of the publishers, we reproduce one—a map showing the author's route, and a full index.

PATENT LAWS.

THE question of our patent law legislation is again coming into prominence, probably owing to its close relationship to other great economic controversies now occupying the mind of the country. It is, however, singular that although this is mainly an economic question, the subject of our patent laws is invariably discussed solely from the standpoint of the inventor. There are in reality two interests which must always be jointly considered, namely the interests of the inventor and the interests of the community.

In a letter which recently appeared in the *Journal* of the Society of Arts, Mr. C. D. Abel, the well-known patent agent, argues that our patent laws are certainly more advantageous to the inventor than either the law of the United States or of Germany. If this be true, may I ask who derives the benefit of our benevolence? Is it not chiefly the foreign inventor and the foreign manufacturer who are the gainers, and our community who pays for it? Natural inventiveness and natural ingenuity being equally spread over the white races, we should possess the portion allotted to a population of forty-two millions as compared with a total white population of roughly 440 millions. It it be true, therefore, as Mr. Abel states, that this country confers greater advantages on inventors than any other, are these advantages not conferred on ten foreign inventors to each one of our own country?

Space forbids me to analyse closely the minor points in which Mr. Abel seeks to find advantages for the inventor in our law not afforded by the American or German law. Let me turn at once to what Mr. Abel calls (from the inventor's point of view) the crux of the question.

Mr. Abel appears to be thoroughly satisfied with the examination into novelty which has been adopted by the Act of 1902. This need occasion no surprise, as he states that he himself proposed the system. I must, however, as I did when Mr. Abel first published them, raise strong objections to the figures by which he attempts to show that the grant of a German patent, in spite of real and thorough examination into novelty, does not confer a better title and greater security to the patentee than a British patent. Mr. Abel states that just the same proportion of litigated patents were declared void in Germany as in Great Britain in the year 1896. I desire to point out that quite apart from Mr. Abel's figures the proportion of patents declared void is a matter of no consequence whatever in this connection. The greater security of a German patent lies in the fact that out of about 15,000 applications to the German Patent Office, less than 6000 are granted. This weeding out of 9000 patents, by a careful and searching preliminary examination, carried out by a competent court, enhances the value of, and gives greater security to, a German patent. In this respect, the Act of 1902, although an improvement on the old Act, is still satisfactory neither to inventors nor to industrial interests. Even if it were true, as Mr. Abel suggests, that as many patents are annually declared null and void in the German courts as in our own, there would be more than one good reason to account for this. Let me briefly repeat some of the reasons, from a pamphlet which I published in 1901.

(1) Probably half of our patents are not worth fighting for, as they are not worth the paper on which they are printed.

(2) Patent legislation, in this country, for a man of moderate means spells financial ruin, while in Germany redress is open at a very much smaller expense.

(3) Account must be taken of the difference in the length of life between English and German patents.

But Mr. Abel's figures are misleading. Whether he intentionally took the year 1896 in order to strengthen his case or merely at random, as he says, is of little importance. The fact remains, and this he ought to have known, that fair or trustworthy conclusions cannot be arrived at by statistics of a single year. I took the trouble to point out to Mr. Abel in 1901 that 1896 was an exceptional year, and prepared a table from official sources, which covers not only 1896—Mr. Abel's year—but also four preceding years. This table, being prepared from accurate official sources, was necessarily arranged in a slightly different manner. It did not include patents litigated or patents partially invalidated; as no trustworthy statistics exist, a good deal of patent litigation is carried on without coming into court, or without being published in the official report of patent cases.

Mr. Abel's Table.

Patents 1896	Patents granted	Patents litigated	Patents wholly or partially invalidated
Great Britain	14,105	29	13
Germany	5,410	102	43

Table Compiled from German Official Sources for 1892 to 1896.

Year	Applications	Patents granted	Patents invalidated, including patents withdrawn
1892	13,126	5,900	10
1893	14,265	6,430	12
1894	14,964	6,280	22
1895	15,063	5,720	18
1896	16,486	5,410	32

It will be seen from this table that thirty-two patents were withdrawn and invalidated in 1896, whilst the average for the four preceding years is only 15·5 per annum. So much about Mr. Abel's figures.

I quite concede that a searching and real preliminary examination is a controversial subject, but from an economic standpoint it must be admitted that the want of conformity existing between our law and that of Germany as to preliminary examination inflicts great injury on our trades. For example, the grant of a British patent to a foreign applicant which his own country has refused to him benefits the foreign country at our expense, the loss to us being proportionate to the value of the invention.

The compulsory working of foreign patents in this country is, however, a far more serious question than "preliminary examination as to novelty." The Act of 1902 only dealt with compulsory licenses, and, so far as it goes, it is an improvement of the old Section 22, but more stringent measures are wanted to make

our law conform to that of our Continental rivals. We require, in the interests of our home trades and industries, that a patent shall be forfeited if it is worked abroad and not in this country.[1]

The grant of compulsory licenses has many disadvantages. It requires often years of hard work, ingenuity, and the training of an experienced staff before a patented article can be profitably manufactured on the large scale. Is it reasonable to expect that the foreign owner of the patent will impart such knowledge to the applicant for a compulsory license, or afford him any aid beyond the meagre details of the patented process? Quite independently of this, the owner of the patent will cause as much delay as possible before he grants the license, and, in any circumstances, no application for a compulsory license can be made before the lapse of three years from the date of application. In addition, the onus is thrown on the British applicant to show that the non-working of the patent is unfairly prejudicing any existing or the establishment of any new industry. There is thus little inducement to home manufacturers to take out licenses for foreign patents, and thereby to introduce the manufacture of the article into this country. The non-working of foreign patents has inflicted incalculable harm on our trades. There is, in my opinion, only one effective measure with regard to working foreign patents, and this is to make it compulsory to work them on an adequate manufacturing scale say twelve months from the date the invention is worked in foreign countries. We have more reason, or at least our interests demand it in a higher degree than those of any other country in the world, to insist that the onus should be on the foreign owner of a patent to work the monopoly which we have granted to him in this country so long as it has been proved that the patent is workable. The working of patents is an economic question of the highest importance, but it ought not to be discussed from the platform of either the free importer or the protectionist. Its consideration is beyond the present fiscal controversy because the grant of a monopoly to any person, that is, the grant of a sole and exclusive privilege, is in itself the highest form of protection, but our legislature since the time of James I. has established this form of monopoly, and rightly continued to exercise it.

Before James I.'s time, patents were granted to any one—not necessarily an inventor—who introduced a new manufacture into this country, and I think not unjustly. The man who establishes a new manufacture does more good to the community than thousands of patentees who work monopolies which we have granted to them outside of this country.

The first Patent Act, the Statute of Monopolies of James I., introduced so far a change that it confirmed the right of granting patents to the first and true inventor, but on the condition that he introduced a new manufacture in this country. This law has been enforced to this day by every prominent industrial country in Europe except by ourselves, and I will now endeavour to show why no country in the world has a greater interest than our own to insist that the grant of a foreign patent should be on the condition of its being worked in this country always provided that it is worked abroad.

(1) We grant a far larger number of monopolies to foreigners, and on much easier terms, in consequence of a lack of a thorough examination into novelty, than other European countries.

(2) Progress depends on improvements and new inventions; we are, however, as little self-contained as regards the supply of ideas as we are with regard to the supply of food. We must largely rely on foreign inventions for the reason that our population is only a small portion of that of Europe and America.

(3) We have free imports, whilst the foreign patentee is protected by high tariffs. It is therefore, as a rule, not in his interest to work in this country the monopoly which we have granted to him. He prefers to work it in the country which gives him high protection, with the additional advantage of selling to us his patented article, without any restrictions, and at his own price. This is the converse to dumping. Nor has he any other inducement, special circumstances excepted, voluntarily to establish new industries in the United Kingdom. Our patent law does not attract him, nor does our high duty on alcohol, nor do higher wages and shorter hours, nor our rates for transport, which are about twice as high compared with those, for example, of Germany. The want of compulsory working is one of the reasons that for the last twenty years we have established so very few new trades or industries in comparison with other nations.

It is, therefore, of grave importance that our legislature ought only to grant monopolies on the clearly defined condition that such monopoly must be worked within this country. We stand in serious need of finding additional occupation for our people. Employment in our staple industries we do positively know is declining, with one or two exceptions, nor is the total increase in the number of persons employed in all trades adequate to the nett increase of our population. The latter contention may be at least safely assumed by the fact of rapidly increasing emigration, and the increase in the number of unemployed and of those who are working at a starvation wage.

America is the only industrial country of any importance which does not insist on the working of a patent, nor does she require such an enactment. She has protected herself by almost prohibitory tariffs, which in themselves afford the greatest inducement to the owner of a patent to work it or get it worked, instead of paying exorbitant import duties, which, in many instances, may nullify the advantages of the patented improvement. It may be generally said that the higher the import duties the less the necessity for compulsory working, and *vice versâ*, the lower the import duty the more stringent should be the law as to working. There cannot be any doubt that had we amended our patent laws in 1877, when patent laws were first established in Germany, in such a manner as to make them conform to the latter, a large number of industries would have been established in this country which do not exist to-day. The German patent laws have largely stimulated enterprise, and (as Privy Councillor Dr. Otto Witt said a few years ago) "have conferred incalculable advantages on German trades and industries."

Ours have been chiefly instrumental in advancing the industrial and commercial interests of our foreign competition. The whole nation is in arms, for and against, when it is a question to put a shilling tax on corn, but we are content to leave to a few lawyers and patent agents the decision of a question of a purely economic character which largely involves our industrial and commercial future. When is our

[1] At the annual meeting of the Association of Chambers of Commerce of the United Kingdom held in London, the following resolution was passed on March 10, that "whilst welcoming the instalment of reform secured by the Patent Law Amendment Act of 1902, further amendment is needed in order to secure the forfeiture of all foreign patents for inventions workable in this country, which are not so worked within a reasonable limit of time."

legislature to wake up and appreciate the fact that we must, by all legitimate means, encourage the establishment of new industries within this realm?

IVAN LEVINSTEIN.

BIRD MIGRATION IN GREAT BRITAIN AND IRELAND.

THE great inquiry on the migration of birds as observed in Great Britain and Ireland instituted in 1880 by the British Association was brought to a conclusion at the Southport meeting last year, and it may be useful to describe shortly what it accomplished, and to direct attention to some of the results, which practically remain unknown except to a few ornithologists specially interested in the subject.

For eight years, 1880–1887, the committee appointed collected voluminous observations from the numerous light stations, some two hundred in number, around the British and Irish coasts. From the enormous amount of material thus amassed, a digest of the observations was prepared and presented to the Liverpool meeting, and was published in the report of the Association for 1896 (pp. 451–477), affording, in a highly condensed form, the general results of the inquiry in all its aspects, geographical, seasonal, meteorological, &c. This was followed by a series of histories wherein each and every movement (and the very varied conditions under which they are performed) of eight birds carefully selected so as to include every type of British migrant was exhaustively treated.

These histories appeared in the reports for the years 1900, 1901, 1902 and 1903.

Turning now to some of the special results of the inquiry, in the first place it was clearly proved that a considerable proportion of our native-bred song thrushes, blackbirds, skylarks, starlings, rooks, lapwings, and other species which are usually regarded as being wholly resident throughout the year are migratory; indeed, they are as essentially summer visitors to our isles as the swallow and the cuckoo. They leave us before the end of summer for southern Europe, and are the first harbingers of spring to appear on our shores, arriving during February and early March.

As regards the geographical aspect of the subject, perhaps the most interesting of the varied movements investigated, if not actually discovered, are those remarkable intermigrations which take place between the south-eastern coast of England and the opposite shores of the continent by a westerly autumn and easterly spring flight. Day after day in late September and during October, when the weather is suitable, vast numbers of skylarks, starlings, chaffinches, tree sparrows, rooks, and jackdaws rush across the southern waters of the North Sea, proceeding chiefly due west off the mouth of the Thames (the centre of the stream), south-west off the coast of Kent, north-west off Norfolk, and north-north-west off the Humber. Corresponding return migrations, in opposite directions, are witnessed in the spring. A noteworthy feature of these movements is that they are performed during the daytime; indeed, they are the main diurnal flights observed on the British coasts.

During the preparation of the digest and of the various reports, I was so much impressed with the singularity and importance of these movements that I decided to make some further investigations regarding them, and to this end I spent nearly five weeks on the Kentish Knock light vessel, situated thirty-two miles east of the Essex coast and out of sight of land, during the past autumn (see *Ibis*, pp. 112 142). I was previously uncertain as to whence came these hosts of migrants, now I am of opinion that they are emigrants from western central Europe, which, having probably descended the Maas, Rhine, and Schelde, quit the Dutch coast at the mouths of those rivers *en route* for winter quarters. Some of these remain during the winter in England, others proceed to Ireland, and others, again, depart from our southern shores for more southern lands. There can be little doubt that many of those which remain in our islands *winter in latitudes north of their summer homes*!

Turning next to the meteorological aspect of bird-migration, it has been possible to make a careful comparison between the unique data obtained through the inquiry and the reports issued by the Meteorological Office, and thus to establish satisfactorily certain relations between migrational and meteorological phenomena. For instance, it has been found that each great arrival on our shores of migrants from north-west Europe in the autumn is correlated with a certain type of pressure distribution which establishes fine weather over the North Sea between Scandinavia and the British Isles. Such conditions, however, though they may prevail at the all important point of departure, and hence induce migration, do not always extend so far as Britain, and when this is the case the migrants pass into more or less unfavourable weather ere they reach our shores.

During a month's sojourn in the Eddystone Lighthouse (see *Ibis*, 1902, pp. 246–269) in the autumn of 1901, I paid special attention to the weather conditions under which the migrants set out to cross the Channel. I found that no movements were witnessed when the weather was in the least degree unfavourable for the passage, and that the wind is undoubtedly the main factor in migration meteorology. The direction of the wind was of no moment, for the birds flitted southwards in winds from all quarters. It was otherwise when its velocity came to be considered, and no movements were performed when this exceeded about 28 miles an hour. At 34 miles the few stragglers observed were in distress, and the only birds moving when it exceeded this and approached 40 miles were swallows and martins. My subsequent experiences at the Kentish Knock Lightship confirmed these conclusions.

The supposed influence of the *direction* of the wind on migratory movements has been much misunderstood, chiefly because the dependence of the wind upon atmospheric pressure does not appear to have been taken into consideration. We now know that certain types of pressure distribution are favourable for and conducive to migration, and the winds also resulting therefrom have erroneously come to be looked upon as the cause for such movements.

Finally, the investigation of certain movements, namely, the emigrations, has presented exceptional difficulties, due chiefly to the fact that they are habitually performed under conditions which enshroud them in all but complete obscurity, indeed, often in complete obscurity. The reason for this is that, with few exceptions, emigration is undertaken during the hours of darkness, and thus entirely escapes notice at the place of embarkation. It was with the object of investigating this phase in the phenomenon of migration that led me to visit the Eddystone, where it was possible to observe these emigrants immediately after their departure from our shores. There I found that at least 90 per cent. of the various emigrants crossed the Channel during the night. Indeed, night movements are undoubtedly the rule when considerable expanses of sea have to be traversed. To this rule the chief exception has already been mentioned; but both at the lighthouse and at the lightship I found that day migration was confined to a few species only.

WM. EAGLE CLARKE.

NOTES.

THE seventy-fourth annual meeting of the British Association will commence at Cambridge on Wednesday, August 17. The president elect is the Right Hon. A. J. Balfour, and the presidents of the sections will be as follows:—A, mathematical and physical science, Prof. Horace Lamb, F.R.S.; B, chemistry, Prof. Sydney Young, F.R.S.; C, geology, Mr. Aubrey Strahan, F.R.S.; D, zoology, Mr. W. Bateson, F.R.S.; E, geography, Mr. Douglas W. Freshfield; F, economic science and statistics, Prof. W. Smart; G, engineering, Hon. C. A. Parsons, F.R.S.; H, anthropology, Mr. Henry Balfour; I, physiology, Prof. C. S. Sherrington, F.R.S.; K, botany, Mr. Francis Darwin, F.R.S.; L, educational science, the Lord Bishop of Hereford; conference of delegates of corresponding societies, chairman, Principal E. H. Griffiths, F.R.S. On Friday evening, August 19, a discourse on "Ripple Marks and Sand-dunes" will be given by Prof. G. H. Darwin, F.R.S.; and on Monday, August 22, Prof. H. F. Osborn will deliver a lecture on "Recent Explorations and Researches on Extinct Mammalia."

THE King has approved of the award of the Royal Geographical Society's Royal medals for this year to Sir Harry Johnston and Commander R. F. Scott, R.N. The award to Sir Harry Johnston is made for his explorations of Africa and his investigations of African fauna, flora and peoples; that to Commander Scott for the work accomplished by the Antarctic expedition during its first year in the Antarctic, and for his Antarctic sledge journey when he travelled nearly 300 miles farther south than any of his predecessors. The Murchison grant of the Royal Geographical Society has been awarded to Lieut. Colbeck for his services while in command of the Antarctic relief expedition. The Gill memorial is to be presented to Captain Irizar, of the Argentine Navy, for his rescue of the Nordenskjöld Antarctic expedition. The Cuthbert Peek grant has been awarded to Don Juan Villalta for his geographical discoveries to the east of the Andes while in command of a Peruvian exploring expedition; and the Back grant to Dr. M. A. Stein for his geographical work in Central Asia, and especially for his mapping in the Mustaghata and Kuen Lun ranges.

REUTER reports that two rather severe shocks of earthquake were felt on Monday afternoon at Temir-khan-shura, in the province of Daghestan, in the Caucasus.

THE twelfth "James Forrest" lecture of the Institution of Civil Engineers will be delivered by Mr. Dugald Clerk on Thursday, April 21, the subject being "Internal Combustion Engines."

A SEVERE storm was experienced in the island of Réunion on March 21 and 22. The barometer fell to nearly 28 inches. The damage appears to have been very great.

THE *British Medical Journal* announces that Dr. Percival Wright has resigned the chair of botany in Trinity College, Dublin, after thirty-six years' service. He has consented, however, to continue to act as keeper of the herbarium.

GENERAL BASSOT has been appointed director of Nice Observatory in succession to the late M. Henri Perrotin. General Bassot is a member of the Bureau des Longitudes, and succeeded the late M. Faye as president of the International Geodetic Association last year.

THE following motion was agreed to by the council of the Central and Associated Chambers of Commerce at a meeting held on Tuesday:—"That this Chamber would welcome a measure to facilitate a more practical system of weights and measures than now in use in this country by the introduction of a decimal system, but not by adopting the metric system, which has no affinity to any existing denomination used in trade or commerce in the United Kingdom."

SOME important changes in the constitution and management of the New Zealand Institute were made during the last session of the New Zealand House of Representatives. Under the New Zealand Institute Act of 1867 the institute was controlled by a board of governors consisting chiefly of members nominated by the Government, the different local institutes (now eight in number) incorporated with the institute being represented only by three members chosen by the board from nominations made by these eight incorporated institutes, and the director of the Geological Survey was by the Act made the permanent manager of the institute. This position has been filled for thirty-five years by Sir James Hector, under whose editorship the first thirty-five volumes of the *Transactions* of the new institute have been published. Shortly after Sir James Hector retired, at the end of June, 1903, an Act was passed by the New Zealand Parliament by which the institute was separated from the Geological Survey, the Colonial Museum and other Government departments with which it had been more or less intimately associated in the past, and at the same time the constitution of the board of governors was altered, so that it now consists of the governor, the Colonial Secretary, four members nominated by the Government, two elected by each of the incorporated institutes at Auckland, Wellington, Christchurch and Dunedin, and one by each of the institutes at the smaller centres. The whole control of the institute and of the publication of its *Transactions* is entrusted to this board, which has also the power of electing the president of the institute. The first meeting of this newly constituted board was held in Wellington in January last, when Captain F. W. Hutton, F.R.S., was unanimously elected president, and Mr. A. Hamilton, curator of the Colonial Museum at Wellington, was made editor of the *Transactions*. The board decided to direct the attention of the Government to the urgent necessity of investigating the fauna and flora of the outlying islands of New Zealand and of preserving them so far as possible from destruction. Other matters of more local interest were dealt with, and the board showed that it is likely to be a vigorous body, and will leave no stone unturned in its efforts to advance the interests of science in New Zealand.

REFERRING to a note in the issue of March 17 commenting on an article by him in the *Field Naturalists' Quarterly*, Mr. R. H. Wallace writes to say that the schemes of work in connection with spring flowers to which attention was directed in our note "are schemes that have been actually carried out by their authors in the schools they represent."

THE directors of the Cunard Company have decided to adopt turbines in the new fast steamers to be built under the agreement with the British Government. A committee was appointed by the company last September to consider the question, and its report has been presented to the directors. The work of the committee has been largely experimental. Two series of comparative tests have been carried out, one on shore at the Neptune Bank station of the Newcastle-on-Tyne Supply Company, and the other afloat with the steamships *Arundel* and *Brighton*, of the Newhaven-Dieppe route. The results obtained with the two steamships were exactly comparable, as the *Arundel* and *Brighton* are practically sister vessels. The only difference is in the machinery, the *Brighton* having turbine engines and the *Arundel* reciprocating engines. During the whole

period of the investigations the committee has realised that fitting turbines of the dimensions necessary to propel the new Cunard ships at the speed contemplated involves a very great step in marine propulsion, the largest turbines at present in use afloat being those in the steamship *Queen*, engaged on the Calais-Dover service.

We have received a copy of *Deutsches Meteorologisches Jahrbuch fur* 1902, containing the results of the meteorological observations at the stations under the control of the Deutsche Seewarte. This is the twenty-fifth annual volume of this very valuable publication, and forms, as our readers are aware, but one portion of the useful work that falls to the share of the establishment in question. We need hardly mention how actively the Seewarte is engaged in the prosecution of weather telegraphy and ocean meteorology; it is probably not so well known that, in conjunction with the Danish Meteorological Institute, it publishes a most laborious series of daily synoptic weather charts for the North Atlantic Ocean, in quarterly volumes, which furnish a valuable aid to the study of the cyclonic systems that form so important a factor in the weather conditions of western Europe. The *Jahrbuch* referred to above contains a summary of all the storms which visited the German coasts in 1902, compiled from the registers kept at the storm signal stations in connection with the Seewarte; we think this by no means light compilation is an important appendix to the work.

A communication has been received from Mr. A. Apps in which he desires to point out that the claim of anything new or special can hardly be sustained in respect of the interrupter referred to in our note on p. 470 (March 17). He states that in or about 1858 the late Mr. Ladd made a contact breaker for Mr. J. V. Gassiott, F.R.S., in which the hammer was so arranged as to knock away the contact between the platinum studs very suddenly; this coil gave 12 inch sparks, but when fitted by Mr. Apps with one of his 10 inch contact breakers in 1899 a $14\frac{1}{2}$ inch spark was obtained. Another interrupter on the Gassiott model, made for Mr. Baines in 1868, was discarded after many experiments. About 1866 a coil designed by Cromwell Varley, F.R.S., was fitted with a hammer arranged to produce a very sudden break, and this also was replaced a few years later by one of the Apps form. Mr. Apps further states that for the last thirty years it has been usual for his coils to give a 10 inch spark with 2 cells (4 volts), and that he has now a coil giving 12 inches freely with a 2 cell storage battery. It may be added that our remark as to the new arrangement performing what the inventors claimed referred rather to the length of spark obtained with a given battery power than to its merits compared with other forms, and it should have been stated that while the 10 inch spark was obtained with the greatest ease from two four-volt storage cells, even an electromotive force of four volts was capable of producing a spark of this length.

In a couple of short printed notes Prof. Moriz Kuhn, of Vienna, describes simple apparatus adapted for class-room demonstrations of Torricelli's theorem, Boyle's and Dalton's laws, and other properties of gases. With a slight modification, a very fair vacuum tube can be obtained with one of the apparatus, or it can be used as an open tube manometer. The whole apparatus is made by Karl Woytacek, 10 Frankengasse, 9th district, Vienna.

Messrs. Vieweg and Son, of Brunswick, have issued a fourth edition of vol. i. part iii. of Dr. Alex. Wernicke's "Lehrbuch der Mechanik." It forms a complete treatise on the theory of elasticity as applied to engineering problems, and deals at considerable length with the statics of loaded beams. In this part of the subject considerable use is made of graphic methods. The book is peculiarly adapted to students of German technical schools, but it also meets the requirements of certain university students and candidates for higher teachers' certificates in that country. It covers a field of study which does not receive the attention which it ought to have in this country; probably no English text-book exists which is written on the same lines. It should receive the careful attention of lecturers on applied mechanics.

A preliminary report on the lead and zinc deposits of south-western Wisconsin, by Prof. U. S. Grant, has been issued as *Bulletin* No. 9 of the Wisconsin Geological and Natural History Society. In order to render the work useful to the public in general, there is a popular account of the physical features, geology, and genesis of ore deposits, occupying half of this little volume. The lead and zinc ores occur in Cambrian, but mainly in the Trenton and Galena Limestones of the Ordovician. The original minerals of the ore-deposits are the sulphides, galena, sphalerite and marcasite. Smithsonite and iron oxides are secondary minerals, having been formed from the alteration of the original sulphides. The secondary minerals occur in the rocks above the level of ground water, or in the belt of weathering. The original minerals, with the exception of galena, which is closely associated with both the original and secondary minerals, occur below the level of ground water. The order of deposition is noted as (1) marcasite, (2) sphalerite (sometimes with galena), (3) galena. The author points out the method of occurrence of the ores, and explains their origin as due partly to deep-seated or artesian circulation of water, and partly to down water circulation. The methods of mining and the resources of the area are duly considered.

The March number of the *National Geographic Magazine* deals chiefly with Manchuria and Korea. A good war map, with insets, prepared by the American War Department, is included, and there is a specially valuable account of Russian development of Manchuria by Mr. Henry B. Miller, United States Consul at Niuchwang.

Except for a note by Mr. D. W. Freshfield on the road to Tibet, the current number of the *Geographical Teacher* is chiefly devoted to reports of the proceedings of the Geographical Association, of conferences on the teaching of geography, and to reprints of papers read. The discussion on the Royal Geographical Society's syllabus, by experienced school teachers of the subject, is of special interest and value.

The February number of *La Géographie* contains articles on the Lenfant expedition, which has discovered a continuous watercourse between the Logone and the Benoué, *i.e* between the Tchad and Atlantic basins; on the exploration of Bolivia; on the province of Bathang; and on the country of the Hereros. There is also a number of valuable notes, including one on the utilisation of water-power in la Mayenne and la Manche, and another on the present state of the Russian geodetic and topographic surveys.

We learn from the *Bulletin* of the Society of Naturalists at St. Petersburg (No. 1) that a new expedition for the exploration of the Caspian Sea is to be sent out early this spring. It is a continuation of the Aral-Caspian expedition which worked some thirty years ago. The party will

include such explorers as MM. Knipovitch and Lebedintseff, well known by their explorations of the White and the Black Seas. The chief aim of the expedition is the hydrobiological exploration of the Caspian Sea and the biology of the Caspian herring

THE *Memoirs* of the St. Petersburg Society of Naturalists (botanical section, vol. xxiii.) continue to bring out new fascicules of the valuable work, "Flora Caucasica Critica," by MM. N. Kuznetsoff, N. Busch, and A. Fomin. The descriptions of the species and varieties are given in Latin, as also all the indexes and the indications concerning the geographical areas of each species; but the remarks added to the above, sometimes extremely interesting, as also the introductory notes to each family, are in Russian.

THE identification of Mexican and Central American plants is receiving special attention from workers in the Gray Herbarium of Harvard University. Mr. J. R. Johnston has contributed to the *Proceedings* of the American Academy of Arts and Sciences a revision of the genus Flaveria, which belongs to the order Compositæ. This genus may be described as Mexican, but is not confined to the country. In a paper published in the *Proceedings* of the Boston Society of Natural History, Mr. B. L. Robinson also deals with plants collected in Mexico and Central America, and describes several new species, amongst others, for the genera Eupatorium, Mikania and Mimosa.

AMONGST the plants forwarded from British New Guinea by the Lieutenant-Governor to Mr. F. Bailey, the colonial botanist in Queensland, to be named by him, the more interesting are a species of Citrus which seems to be suitable for a graft-stock; a euphorbiaceous plant, *Baccaurea papuana*, which, as in the case of other species of the genus, provides edible flowers and fruit; and *Pangamia glabra*, a leguminous plant, of which the leaves and seeds are known to possess therapeutic properties. The recent additions to the flora of Queensland made by Mr. Bailey have either been incorporated into his book direct or have appeared in the *Queensland Agricultural Journal*, but a *Bulletin* was issued last year by the Department of Agriculture which contains a list of newly recorded fungi.

WE are glad to see that Mr. Thompson, who has so long held the office of deputy superintendent and head-keeper in the Gardens of the Zoological Society, has been rewarded with the society's silver medal in recognition of his conspicuous success in the management of the animals under his charge.

NOS. 4 and 5 of the first volume of the *Physiological Publications* of the University of California contain reports of two addresses—one by Prof. W. Ostwald on the relations of biology and the neighbouring sciences, and the other by Prof. J. Loeb on the limits of biological research—delivered at the dedication of the Rudolph Spreckel Physiological Laboratory in August last.

JUDGING from its thirty-seventh report (for last year), that admirable institution, the Rugby School Natural History Society, continues to enjoy a flourishing career, and to be well supported by the members of the school. Among its contents is an illustrated paper by Mr. J. C. F. Fryer on British thrushes, admirable in general plan, but in which the author seems in certain instances to use the term "genus" where he means "group."

THE *Naturalist* for February contains a reproduction (from the *Transactions* of the Entomological Society) of one of Prof. Poulton's beautiful and instructive plates illustrating the colour adaptations of caterpillars to their surroundings under artificial conditions. Among the contents of the March number of the same serial is a description, by Mr. C. T. Trechman, of flint implements of Neolithic age discovered on the coast of Durham.

IN a note on the osteology of some berychoid fishes (the group typified by the members of the family Berychidæ, or slime-heads), published in the *Proceedings* of the U.S. National Museum (No. 1366), Mr. E. C. Starks directs attention to a distinctive feature of the occipital region of the skull. In ordinary percoid fishes the basioccipital forms a concave surface with a deep pit in the centre, while the exoccipitals are small and in most cases separate, and present flat oblique facets for the atlas vertebra. In the berychoids, on the other hand, the exoccipitals are large, extensively in contact in the middle line, and form with the basioccipital a regularly concave surface for the atlas. It may be added that in calling this surface a "concave condyle," the author utterly traverses the etymological significance of κόνδυλος, which signifies a convex knuckle.

WE have received from the secretary the abstract of a paper read at a meeting of the Society for Psychical Research on March 21 by Dr. Albert Wilson. It is interesting as containing an account of a patient who suffered at the age of 12½ years from influenza, followed by meningitis, and in consequence developed a multiple personality. The case appears to be strictly analogous to similar cases already reported (*e.g.* James's "Psychology," p. 383 *sqq.*), except that the "personalities" attained the unusual number ten. Such cases are usually hypnotic; in this instance Dr. Wilson lays stress on the dependence of the various states on the comparative activity of different cortical layers. Dr. Wilson suggests that the brain may be composed of "districts, each district representing a personality or small ego"; we agree with him that "the whole subject requires more extended investigation," and the case he describes is certainly an important datum.

HALF-VOLUME VI. of the "Natural History of Animals," by Prof. J. R. Ainsworth-Davis, has now been published by the Gresham Publishing Company, of London. This part, of what is a very well illustrated publication, deals largely with animal development and animal life-histories.

A NEW catalogue has been issued by Mr. Thomas D. Russell, of 78 Newgate Street, London, E.C., giving full particulars of collections to illustrate lectures and demonstrations in geology, physiography, and mineralogy, as well as of all material required by prospectors and mining engineers. The collections prepared to accompany instruction from well-known text-books of these subjects of natural science should be a great convenience to teachers.

MESSRS. MACMILLAN AND CO., LTD., have published several separate parts of "A School Geometry," by Messrs. Hall and Stevens, already reviewed in these columns. We have received the following volumes:—parts i.–iv., containing the substance of Euclid Books i.–iv., price 3*s.*; parts iii.–iv., containing the substance of Euclid Books ii. and iii., and part of Book iv., price 1*s.* 6*d.*; and parts iv.–v., containing the substance of Euclid Books ii., iii., 35–37, and Book vi., price 2*s.*

WE have received a copy of the new edition of the full catalogue of general testing and scientific instruments manufactured by Messrs. Nalder Bros. and Co., of Westminster. This profusely illustrated volume should prove of real assistance to teachers of science responsible for the equipment of physical laboratories, and, as it is five years

since the last list of Messrs. Nalder Bros. and Co. was published, a number of new instruments used for scientific instruction and research are included in the present catalogue.

A NEW impression of Sir Oliver Lodge's "Pioneers of Science," which originally appeared in 1893 (see NATURE, vol. xlvii. p. 268), has been published by Messrs. Macmillan and Co., Ltd. The book is an interesting narrative of the careers and investigations of great astronomers whose contributions are links in a chain of scientific history. Personal details give living interest to the work, and the essential points of progress are clearly displayed. But why has not Sir Oliver Lodge taken the opportunity which a new issue afforded him of substituting reproductions of astronomical photographs for the caricatures which appear as representations of star clusters and nebulæ? Figs. 43, 48, 80, 87, 89 and half a dozen others could easily have been superseded by pictures from photographs, instead of being left to irritate astronomers who know what beautiful illustrations are available and to mislead students who have not seen the objects depicted or photographs of them. Fig. 47, explaining the phases of the planet Venus, is upside down.

THE first part of the third volume of *Biometrika* has now been issued by the Cambridge University Press. In addition to miscellanea the following papers are published:—on the result of crossing Japanese waltzing mice with albino mice, by Mr. A. D. Darbishire; graduation of a sickness table by Makeham's hypothesis, by Mr. John Spencer; the measurements of 130 criminals, by Mr. G. B. Griffiths, with an introductory note by Dr. H. B. Donkin; a preliminary note on the protective value of colour in *Mantis religiosa*, by Mr. A. P. di Cesnola; a first study of the weight, variability, and correlation of the human viscera, with special reference to the healthy and diseased heart, by Mr. M. Greenwood, jun.; and a paper in Italian, "Sui Massimi delle Curve Dimorfiche," by Signor Da Fernando de Helguero.

IN the *Journal* of the Society of Chemical Industry for February 15 Messrs. R. S. Hutton and J. E. Petavel describe methods for the preparation and compression on a large scale of pure gases for experimental work. The experimental plant required for the production of large quantities of hydrogen, nitrogen, carbon monoxide and ethylene, at a rate of about 100 litres per hour, is illustrated by diagrams, and interesting facts concerning the compression and storage of these gases are communicated.

IN a communication to the *Journal of Physical Chemistry*, vol. vii. p. 557, Dr. J. W. Mellor points out that the theory that water is in many cases essential to chemical change is of much earlier date than is generally supposed. Mrs. Fulhame, in 1794, appears to have been the first to give a clear statement of the influence of water on chemical transformations, and her observations were published in a work entitled "An Essay on Combustion with a View to a New Art of Dyeing and Painting wherein the Phlogistic and Antiphlogistic Hypotheses are proved Erroneous." In many respects Mrs. Fulhame's theory accords with present-day views.

IT has been known for a considerable time that the products obtained in the electrolytic reduction of nitrocompounds depend upon the nature of the kathode plates. By the reduction of nitrobenzene in alkaline solution azoxybenzene is obtained with platinum and nickel kathodes, azobenzene with lead, tin and zinc kathodes, and by using kathodes of copper, aniline appears as the reduction product. In the current number of the *Zeitschrift fur physikalische Chemie* Messrs. Löb and Moore show that the essential factor in determining the reduction is the kathode potential, and with a given kathode potential the same products are obtained in approximately constant proportions independent of the nature of the kathode material.

THE experimental determination of the density of fluorine, made by M. Henri Moissan shortly after the isolation of this element, gave the number 1·260, considerably lower than the figure required by the atomic weight of fluorine, 1·319, and on this account the suggestion has been put forward by Brauner that a certain proportion of free atoms was present in the gas, thus accounting for its remarkable chemical properties. In the current number of the *Comptes rendus* M. Moissan has again taken up this question, with minute precautions regarding the purity of the gas, the result of four experiments being 1·298, 1·319, 1·313, 1·312, or a mean of 1·31. The agreement between the experimental and theoretical figures is thus sufficiently close to disprove the existence of any considerable proportion of free atoms in the gas.

THE additions to the Zoological Society's Gardens during the past week include an Otter (*Lutra vulgaris*), British, presented by Mr. Radcliffe Saunders; a Red Fox (*Canis fulvus*) from North America, presented by Mr. E. W. Bishop; a Lesser Sulphur-crested Cockatoo (*Cacatua sulphurea*) from Moluccas, presented by Miss L. Newman; a Bateleur Eagle (*Helotarsus ecaudatus*) from Africa, presented by Dr. W. J. Ansorge; a Jardine's Parrot (*Poeocephalus gulielmi*) from West Africa, presented by Mr. A. Willoughby Osborne; a White-eared Bulbul (*Pycnonotus leucotis*) from North-west India, presented by Mr. G. Dendle; four Common Pheasants (*Phasianus colchicus*), British, presented by the Hon. Walter Rothschild, M.P.; a Hybrid Pheasant (between *Phasianus reevesi* and *Euplocamus nycthemerus*), presented by the Earl of Ducie; two Wharton's Fruit Pigeons (*Carpophaga whartoni*) from Christmas Island, two Yellow-eyed Babblers (*Chrysomma sinense*), two Sepoy Finches (*Haemotospiza sipahi*), three Rose-coloured Pastors (*Pastor roseus*) from India, a Purple-capped Lory (*Lorius domicella*) from Moluccas, a Hybrid Duck (between *Metopiana peposaca* and *Fuligula rufina*), a Hybrid Duck (between *Aex sponsa* and *Dafila spinicauda*), European; five Tuatera Lizards (*Sphenodon punctatus*) from New Zealand, fourteen Alpine Newts (*Molge alpestris*), six Marbled Newts (*Molge marmorata*), European; a Red Newt (*Sperlepes rubra*), a Californian Newt (*Molge torosa*) from North America, deposited; three Japanese Pheasants (*Phasianus versicolor*) from Japan, three Bar-tailed Pheasants (*Phasianus reevesi*), two Amherst Pheasants (*Thaumalea amherstiae*), two Silver Pheasants (*Euplocamus nycthemerus*), two Manchurian Crossoptilons (*Crossoptilon mantchuricum*) from China, purchased.

OUR ASTRONOMICAL COLUMN.

ASTRONOMICAL OCCURRENCES IN APRIL:—

April 5. 4h. Ceres in conjunction with moon. Ceres 1° 1′ S.
7. 10h. 38m. Minimum of Algol (β Persei).
10. 7h. 27m. Minimum of Algol (β Persei).
14. 5h. Jupiter in conjunction with Moon. Jupiter 0° 7′ N.
15. Venus. Illuminated portion of disc = 0·927, of Mars = 0·995.
17. 8h. Mercury 7° N.W. of the Moon.

19. Saturn. Major axis outer ring = 37″·74. Minor axis = 9″·05.
20-22. Epoch of April meteors (*Lyrids*, radiant 271° + 33°).
21. 8h. Mercury at greatest elongation east 20° 11′.
22. 22h. Venus in conjunction with Jupiter. Venus 0° 30′ S.
27. 12h. 20m. Minimum of Algol (β Persei).
30. 9h. 9m. Minimum of Algol (β Persei).
,, 18h. 32m. Transit (egress) of Jupiter's Sat. III. (Ganymede).

STANDARD VELOCITY STARS.—In a communication to No. 2, vol. xix., of the *Astrophysical Journal*, M. A. Belopolsky gives an account of the work which has been done at Pulkowa in connection with the international cooperative scheme for the determination of the radial velocities of certain standard stars.

The 36-inch refractor and a new Töpfer spectrograph, similar to the Potsdam IIIa. spectrograph, have been used, and the details of the methods employed and of the provisional results obtained, for six of the velocity stars, are given in the present paper. The results are not so good as might be expected, but it is hoped that better results will be attained during the next year's work. The spectrum of iron was used for comparison, and control spectrograms of the sun, Mars, Jupiter and Venus were obtained. The results for the first three are discussed in the present paper; those for Venus, which are much more comprehensive, are being reserved for a future communication.

OBSERVED MOTIONS IN THE NOVA PERSEI NEBULA.—Prof. J. M. Schaeberle, in a note to the *Astronomische Nachrichten* (No. 3935), points out the great importance of studying every possible condition which may affect the determination of the parallax of the nebula surrounding Nova Persei, for until the parallax is unquestionably known theories regarding the observed movements can only be of a highly speculative character. In determining the actual parallax only the "absolute" method is available, and Prof. Schaeberle suggests that one of the conditions affecting the results might possibly be a refraction of the rays by some interplanetary medium filling the solar system. He contends that it is only reasonable to suppose that a difference of some kind *may* exist between the space void of heated matter and that surrounding an attracting mass radiating both matter and heat. If any medium (either gaseous or ethereal), such as an extended solar atmosphere, does exist, then any light entering such a space would be refracted, and the hitherto determined negative parallaxes are simply the differences between this refraction and the true parallax, where the latter is less than the former; similarly in cases where the measures indicate no parallax the two may be equal and opposite. Thus if this refraction constant were only 1″ the recorded motions in the nebulosity surrounding Nova Persei would be readily explicable, for with a parallax of 1″ they are about equal in magnitude to those occasionally observed in solar work.

A NEW FORM OF EQUATORIAL MOUNTING.—A new form of equatorial mounting, for which the inventor, Herr A. F. Lindemann, of Darmstadt, claims many advantages, is described and illustrated by a diagram in No. 3935 of the *Astronomische Nachrichten*.

The light from the star is collected by an objective placed at the upper end of the polar axis, and by a system of mirrors is reflected down that axis. By suitable mechanism the movements in R.A. and declination are imparted to tubes inside the telescope (*i.e.* the polar axis), and hence to the reflectors, from clockwork of the usual form.

Among the many advantages claimed for this form of mounting are that the observer may remain comfortably seated in a room of uniform temperature, the instrument is very compact and perfectly balanced, the vibration effects are reduced to a minimum, and no large dome with costly mechanism for revolving it is required.

THE LEONID SHOWER OF 1903.—Further evidence that the Leonid shower of 1903 afforded a fairly rich display is given by the observations made at the Royal Observatory at Lisbon. During a watch of 3h. 28m. (15h. 14·7m. to 18h. 42·7m. G.M.T.) on November 15, Senor Campos Rodrigues counted 165 Leonids. At the maximum of the shower during the five minutes' interval from 16h. 46·7m. to 16h. 51·7m. 22 Leonids were counted (*Astronomische Nachrichten*, No. 3936).

THE INSTITUTION OF NAVAL ARCHITECTS.

THE annual general meeting of the Institution of Naval Architects was held last week in the theatre of the Society of Arts, the president, the Earl of Glasgow, occupying the chair. The meeting commenced on the morning of Wednesday, March 23, and was carried on during the two following days. There was on the agenda a list of fourteen papers to be read and discussed, and these, being all dealt with, made, together with the presidential address and other business, a very full programme for each day, possibly too full, considering the sittings did not commence until noon.

As president of the institution, Lord Glasgow yearly gives a general summary of the condition of the shipbuilding and marine engineering industries of the country in his address, which, though brief, contains a quantity of matter which well illustrates Huxley's apothegm as to the need of knowing a great deal to say a little well. His remarks on the future of the steam turbine, on the prospects of internal combustion engines, and on other matters of a like nature indicate that Lord Glasgow is more than a merely ornamental president.

The chief interest in the meeting was doubtless centered in Sir Edward Reed's paper on the two battleships recently purchased from the Chilian authorities by our own Admiralty. These two ships, now H.M.S. *Triumph* and *Swiftsure*—formerly the *Libertad* and the *Constitucion*—were designed by Sir Edward Reed in conjunction with officers of the Chilian Navy. The debates in Parliament, in which the designs of these vessels were compared with those of battleships of the Royal Navy, raised considerable feeling, and the personal element, which always attracts interest, was not absent. It cannot be said, however, that either the paper or the discussion did much to advance the science of warship design. Sir Edward Reed maintained the superiority of his own designs, whilst Sir William White, who was the chief speaker in the discussion, upheld the superior advantages of the ships for which he was responsible. At present the efficiency of designs for warships is an open question upon which critics may hold conflicting opinions without fear of them being proved erroneous, and this position is likely to continue until practical evidence is obtained by the test of actual warfare. Beyond this, however, it is seldom—in fact one may say never—that particulars sufficient for a full comparison of different ships are made public, and it is for these reasons that the controversies in warship design are so barren.

A paper by Lord Brassey which followed, and dealt with the problem of merchant cruisers and steamship subsidies, pointed out the need that would arise in case of war for more scouts than the navy at present possesses, and advocated the use of merchant vessels for this purpose. Here naval opinion was divided, one authority, Admiral Fitzgerald, maintaining that it would be better policy to devote any money available to the building of regular warships rather than to paying subsidies, whilst another admiral, Sir Edmund Fremantle, said that if he had to send a vessel at full speed across the ocean he would select an Atlantic liner, as our cruisers would not be able to maintain so high a speed for so long a period as the mercantile vessel. The question of portable armour, to be shipped in case of war on merchant vessels, was also brought forward, but this was fully discussed by Prof. Biles at a meeting of the institution held just ten years ago.

On the second day of the meeting Sir William White read a paper in which he advocated the establishment of an experimental tank for testing ships' forms by means of models, on the system instituted by the late William Froude at Torquay. At the Glasgow meeting of the institution held in 1901, Mr. Yarrow brought forward a motion proposing that a tank should be established under the auspices of the institution. As a result efforts were made to raise the necessary funds, but although some ship-building firms promised handsome subscriptions, the proposal was not well

backed up. The reason for the failure was attributed to the fact that it was proposed to try models for different firms, and it was feared that difficulties might arise. Sir William now suggests that what might be called the commercial side of the scheme should be abandoned, and that a tank should be constructed for the sole purpose of research work, and investigation into the general principles underlying the science of naval architecture. This would naturally cut off the income it was proposed should be derived from testing models for firms, and therefore a sufficient sum must be collected, not only to build the tank, but also to endow it. The suggestion is that the tank should be constructed at Bushy, and be incorporated as a part of the National Physical Laboratory. The cost of building would be about 15,000*l.*, and the annual cost of staff, maintenance, &c., would be about 1500*l.* Dr. Glazebrook, who spoke in the discussion, said the management of the National Physical Laboratory welcomed the suggestion most cordially, and it therefore only remains to collect the money. The cooperation of ship owners, as well as of ship builders, was asked for, and the general opinion of the meeting appeared to be that it would argue ill for the enterprise and public spirit of the shipping community if the moderate sum needed were not forthcoming.

The next paper read was doubtless the most valuable presented at the meeting. It was a contribution by Mr. R. E. Froude, and detailed some results on model experiments. It is hardly necessary to remind our readers that Mr. Froude has for many years carried on at Haslar for the Government the work in connection with tank research inaugurated by his brilliant father. The details he now gives are the result of experiments carried through a period of thirty years; in fact, the initial trials were made at Torquay by the late Mr. Froude. The details given were of a purely technical nature, and could not be explained without the advantage of much space and many diagrams of ships' forms, &c. Although the details referred to war vessels, they are applicable to mercantile craft within the limits of form included.

A paper by Prof. Scribanti, of the Royal Italian Navy, on the heeling and rolling of ships of small initial stability, was read in brief abstract, and was not discussed.

A paper by Herr Otto Schlick, on the gyroscopic effect of fly wheels on board ship, was read at the evening sitting of Thursday. The author proposed the installation of an enormous gyroscope for the purpose indicated. The suggestion is not new, but the practical difficulties in the way have generally been considered too great to make the plan acceptable to ship designers. Herr Schlick's paper was, however, acceptable as giving in simple language an admirable exposition of the gyroscopic effect.

Two papers, respectively by Mr. J. E. Thornycroft and Mr. A. F. Evans, gave particulars, chiefly of a historical nature, of the application of oil engines to small vessels. The occasion is perhaps notable from the fact that some members present, connected in a practical manner with marine engineering and ship design, considered the use of gas engines for marine propulsion—with gas producers in place of steam boilers as a problem that would have to be considered before long.

At the Friday meeting Prof. Plateau, of Paris, gave particulars of vessels fitted with the form of steam turbine he has invented, notably a first-class torpedo boat built by Messrs. Yarrow and Co. This vessel has made a speed of 26·39 knots. The battle of the turbines is likely to be the great feature in the domain of ship propulsion in the immediate future. Whether the impulse type or the reaction type will prove superior is a question that must be settled by experiment, and further information on this subject is anticipated with interest. The adoption of the steam turbine in the two new Cunard liners, after an exhaustive inquiry by a very competent tribunal, has placed the steam turbine on a firm basis as a means of marine propulsion.

A paper by Dr. J. Bruhn, on some points in connection with the transverse strength of ships, dealt with a problem of such complexity that it has often been considered indeterminable; whilst a second paper by Mr. A. W. Johns, on the normal pressure on thin moving plates, is also one that lends itself to abstruse mathematical consideration.

RECENT DISCOVERIES IN BACTERIOLOGY.[1]

THESE are researches towards a fuller knowledge of the morphology and life-history of various orders belonging to Bacteriaceæ. So far the complete life-history of sporogenous forms had only been worked out for a very small number, all belonging to the genus Bacillus. The discovery of spores in the genus Sarcina, and the acquisition of a pure culture of the same by the author, gave him an opportunity of making a complete investigation of this genus. It includes the treatment of spores with various reagents, the germination, the mode of insertion of cilia, the course of development in various media, mode of cell-division, development of spores, and a number of physiological experiments. With appropriate stains the morphology and inner structure of the cell was examined, the cell being differentiated into membrane cytoplasm and nucleus. The results of metabolism fat, glycogen, &c., were not observed, so the products of protoplasm must be dissolved in the cytoplasm, and cannot at present be examined microscopically. The development of the spore is interesting, and requires a very delicate manipulation of stains. It first appears as a vacuole with a central nucleus embedded in it. The vacuole gets denser, until the young spore now dimly outlined stains more deeply than the neighbouring cytoplasm. Then it differentiates a membrane and gradually becomes very strongly refractive, whilst the rest of the cell almost entirely disappears, being only visible when treated with certain stains. This description tallies with Meyer's account of the development of the spore in the genus Bacillus.

Investigation was also carried into the genus Spirillum, the species *Sp. giganteum* being chosen. The variation of size and form, variation, nature, and amount of reserve matter (fat and "Volutans-kugeln"), the ciliation, the course of development in various media, pathogenic structures, &c., were fully examined, so that a complete diagnosis of the species is in our possession. The formation of spores is unfortunately as yet unknown in this species. In this species the most interesting result was the *demonstration* of the origin of the cilia from the inside of the cell. Some investigators had maintained that the cell had no membrane, beng simply naked protoplasm, and that the cilia arose from the periphery, others that there was a membrane, so that the cilia must arise from the inside. The whole question was purely conjectural, but with appropriate staining, which is given in the text, and shown by drawings, the author proves the latter hypothesis to be the true one.

The most important part of the above researches is that dealing with ciliation. Modern classification subdivides according to the possession or non-possession of organs of motion. It is proved that formation of slime in the artificial cultures of the laboratory is the cause of absence of motion. A method is discovered to prevent this formation, with the result that all the supposed non-motile forms were found to be motile, and from everyone the organs of motion were successfully demonstrated. The investigation included 17 forms from the genus Sarcina, 5 forms from the genus Micrococcus, 3 forms from the genus Streptococcus, and 5 from the genus Bacterium, all indiscriminately chosen. Hence the genus Sarcina is absolutely identical with the genus Planosarcina, Micrococcus with Planococcus, and Bacterium with Bacillus (see Migula's "System der Bakterien"). It is therefore obviously necessary that the subdivision of the families Coccaceæ and Bacteriaceæ must be remodelled. A new classification is proposed for these two families, the essence of which is as follows:—

Family Coccaceae. Round cells, ciliated.

(1) Genus Streptococcus. Division in one direction of space.

(2) Genus Micrococcus. Division in two directions of space.

(3) Genus Sarcina. Division in three directions of space.

[1] (1) "Untersuchungen über Sarcina Streptoccus und Spirillum," *Centralblatt für Bakteriologie*, Abt. I. Bd. XXXIII. (1903.) (2) "Der Nachweis der Geisseln bei allen Coccaceen," *Ibid.*, Abt. II. Bd IX. (1902.) (3) "On the Discovery of Cilia in the Genus Bacterium," *Ibid*, Abt. II. Bd. XI. (1903.) No. 8/9. By David Ellis, Ph.D. (Marburg), B.Sc. (London).

Family Bacteriaceae. Cylindrical forms, ciliated.

(1) Genus Bacillus. Forms with peritrich cilia.
(2) Genus Pseudomonas. Forms with polar cilia.

It cannot but be interesting to medical bacteriologists to learn that the pathogenic Streptococci are motile. At the conclusion of the third paper the exact method by which successful cilia preparations can be obtained is given.

FLUORESCENT BODIES EXCITED BY RADIUM.

SINCE very active preparations of radium have become available, a steady search has been going on in many quarters for agents which will respond to the radiations and convert them into visible light. The most powerful fluorescer towards the α radiations is Sidot's hexagonal blende, a crystallised form of zinc sulphide, which is especially suited for use with the emanation. The most powerful to the β radiation is willemite, a zinc silicate, which gives a magnificent green fluorescence, and is probably quite free from any phosphorescence after the action of the rays ceases. This if left in the radium emanation steadily increases in brightness as the excited activity, and with it the β radiation, is produced, and reaches its maximum some hours after the emanation has been introduced. The same is true of kunzite, a new variety of spodumene discovered by Dr. Kunz, and supplied by Messrs. Griffin and Sons, Ltd. The colour of the light might be variously described by different observers as salmon-pink, warm orange, or orange-yellow, according to individual opinion. Kunzite is a transparent gem-like crystal, and is one of the most beautiful examples of the fluorescent bodies at present available for demonstrating the luminous effects produced by the radium rays. It is, however, not very powerful compared with willemite or the platinocyanides. Being, like the diamond, transparent, it shines especially well when exposed in a tube to the action of the concentrated radium emanation, as the whole mass of the crystal contributes to the light effect. The growth of the luminosity after the emanation is introduced, owing to gradual production of the excited activity, is more marked than in the case of willemite, as kunzite hardly seems to respond at all to the α radiation. This experiment would be instructive as a lecture illustration to prove that the emanation only gives α rays, and that the β rays are produced only when time has been allowed for some of the emanation to change into the matter causing the excited activity.

The most brilliant and exquisite of all fluorescers for demonstration on a large scale are the platinocyanides in the form of large crystals. Those containing lithium give a beautiful pink, not unlike that of kunzite, but more brilliant. The colour of the latter is doubtless due to the lithium contained in it. The calcium and barium salts are characterised by a deep green, especially the former, whereas the sodium compound shines lemon-yellow. Magnesium platinocyanide, which is so beautiful under the X-rays, hardly responds at all to radium. The feeble γ rays are best shown by a large crystal of the barium or lithium salt. Large crystals of the platinocyanides seem extremely difficult to obtain, and any manufacturer who could produce them would probably find a ready market.

A new fluorescent mineral, which, like kunzite, seems to respond only to the β rays of radium, has been recently discovered by Mr. Armbrecht, a member of the firm of Armbrecht, Nelson and Co., chemists, Duke Street, W. The mineral is sparteite, a form of calcite containing a few per cent. of manganese. It occurs associated with willemite and with zincite, the red oxide of zinc, which contains a trace of manganese. It is pure white in colour, and under the action of the β radium rays fluoresces a very deep orange. The light is not at all powerful, but the colour is very remarkable, and would excite comment merely as a fluorescent phenomenon without reference to the way in which it is produced. One authority described it as exactly similar to the colour given by neon in a spectrum tube. It is rather remarkable that the colour seems to depend on the intensity of the rays, and is of a deeper *tint* when the radium is held near than when it is removed a short distance. The same gentleman has discovered among the fluorites some examples of phosphorescence after exposure to radium which persist for several days, and exhibit marked increase of brilliancy on exposure to the warmth of the hand. He finds that kunzite exhibits a similar behaviour, the after phosphorescence (or thermo-luminescence?) being notably increased if the mineral is held in the hand.

The action of kunzite and sparteite under the kathode rays is of interest. In each case the colour is considerably different from that under the action of radium, being much yellower. Sparteite under these conditions is disappointing, but kunzite is a most beautiful sight. Its colour is a pure deep yellow without a trace of the warmth it exhibits under radium.

F. S.

THE PALOLO WORM OF SAMOA.

THE periodical autumnal swarming in the seas around the Samoan Islands of the annelid locally known as the palolo has attracted the attention of residents in those islands and naturalists generally for many years. The swarming takes place in October and November, apparently on the day before the last quarter of the moon, and on this and the following day the sea is absolutely alive with the worms, of which the numbers seem to be greater in the November than in the October swarm. Early dawn is the time for the swarming to commence, and by sunrise the phenomenon is at its height. Not the least curious feature about the swarming is the fact that all the worms are imperfect and headless, and the nature of the complete worm has long been a puzzle to naturalists. Thanks, however, to the investigations of Messrs. Krämer and Friedländer, supplemented by the observations of Mr. W. McM. Woodworth, the solution of the problem has at length been discovered. The results of these investigations have been published in Dr. Krämer's "Die Samoa Inseln" (Stuttgart, 1903), while the original English version of this account, drawn up by Mr. Woodworth, appears in the *American Naturalist* for December last.

Palolo also occur in Fiji and elsewhere. The complete annelid—*Eunice viridis*—burrows into the reef-rock of Samoa, the reef, when prised open with a crowbar, proving shortly before the swarming season to be absolutely alive with palolo. Curiously enough, the Samoan natives, although familiar with the palolo when swarming, are quite unacquainted with it during the period of its rock-boring existence. Owing to the great length of the entire worm, its fragile structure, and its intricate association with the honeycombed reef, the extraction of complete specimens is a matter of considerable difficulty, demanding very delicate manipulation on the part of the operator.

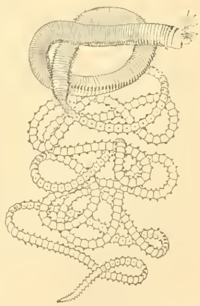


FIG. 1.—*Eunice viridis* (Gray). The narrow posterior epitokal part when detached and free-swimming is known as the "Palolo."

The complete annelid consists of two distinct parts, a broad anterior "atokal" portion, sharply marked off from a slender and much longer "epitokal" portion, which at the swarming season becomes detached and constitutes the free-swimming palolo. The total length averages 40 centimetres, of which about the first fourth is formed by the thick atokal portion. From 250 to 430 is the approximate number of segments in the atokal region, the smaller number occurring in a female and the larger in a male. In the males the colour is reddish brown, and in the females bluish green. These sexual colours are most strongly marked in the epitokal region, where they are due to the sperm and ova, the collapsed integument being quite colourless after the discharge of those elements.

Palolo, as above mentioned, are by no means confined to Samoa. "A similar swarming of marine annelids," writes

Mr. Woodworth "and at corresponding seasons is known for other islands of the Pacific, though the worms have not everywhere been identified. Powell speaks of them in the Gilbert Islands, where they are known to the natives as *te nmatamata*, and Codrington gives a detailed account for Mota in the Banks Islands, where they are known as *un*. Brown mentions the annual occurrence of a palolo on the east coast of New Zealand, and the *wawo* of Rumphius, which occurs at Amboyna, in the Moluccas, is doubtless the same. Seeman mentions the occurrence of the worm in the New Hebrides, and it is known in Fiji and Tonga. It is reasonable to suppose that a systematic search would show the palolo, or some allied form, to have a wider distribution in the coral-reefs of the Pacific than has been as yet recorded. That the annelid is best known from Samoa and Fiji is accounted for by these groups of islands having been most visited and longest inhabited by whites."

We reproduce Mr. Woodworth's figure of the complete worm.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

THE Glasgow University Court has appointed Mr. Frederick Soddy to be lecturer on physical chemistry for five years from October 1 next.

DR. K. ZINDLER and Dr. J. A. Gmeiner have been appointed ordinary professors of mathematics in the Universities of Innsbruck and Prague respectively.

THE authorities of Yale University announce that, in succeeding Prof. J. J. Thomson as Silliman lecturer, Prof. C. S. Sherrington, F.R.S., will treat of "The Cardinal Features of the Integrative Action of the Nervous System" in a course of ten lectures commencing Friday, April 22.

THE preamble of the Victoria University of Manchester Bill has been found proved by Lord Balfour, acting chairman of committees of the House of Lords, and the Bill will be reported to the House for third reading. The Bill is promoted to give effect, so far as Manchester is concerned, to the decision of the Privy Council dissolving the Victoria University as originally constituted of the Owens College, Manchester, University College, Liverpool, and the Yorkshire College, Leeds, and to the grant of charters for the creation of separate universities in each of the three centres. Under the provisions of the present Bill Owens College is incorporated with the Victoria University of Manchester, and the property and liabilities of the college are transferred to the university.

THE Johannesburg correspondent of the *Times* reports that the Transvaal Technical Institute was formally opened on Tuesday in the presence of the Governor and the Lieut.-Governor of the colony. The institute is intended to be the nucleus of the future university which, in the opinion of the commission appointed by the Government to gauge the needs of the community in the matter of technical education, will ultimately be found necessary for the Transvaal. The institute as now inaugurated, has absorbed the Kimberley School of Mines, which for eight years has covered the third and fourth years' courses prescribed by the Cape University for obtaining a degree in this subject. In view of the exceptional opportunities afforded at Johannesburg for mining engineering, arrangements are on foot to enable students of the Royal College of Science and other home institutions to proceed to the Transvaal for a year's post-graduate study.

IN the House of Commons on Monday Sir J. Gorst invited a statement from the secretary to the Board of Education with regard to the physical condition of the children in the elementary schools. In the course of his reply, Sir W. Anson said that the committee of inquiry on physical deterioration began to sit last winter, and they found that the British Association had appointed a committee, of which Prof. Cunningham was chairman, to inquire into the same subject. The committee put itself in communication with the committee of the British Association, which met them in a most cordial spirit. Prof. Cunningham gave evidence, and the scheme already outlined by the British Association committee was sent to the College of Physicians and the College of Surgeons. The College of Surgeons sent back word that they cordially approved of the proposed scheme, that there should be a regular survey of the population of the United Kingdom—of the agricultural and working population and of the children in the schools, and that means should be taken to ascertain their physical condition at the school age. It was hoped that by proper management it might be possible to cover the whole of the United Kingdom in ten years, so that there might be a complete survey of the United Kingdom in the course of every ten years.

LAST week we directed attention to the fact that the Goldsmiths' Company had decided to give up the Goldsmiths' Institute at New Cross at Michaelmas next. The company has now offered to hand over the whole site of the institute (about seven acres), together with its buildings, equipment, and apparatus complete, to the University of London for the purpose of promoting university work in South London. The Senate of the University has resolved, subject to the satisfactory settlement of administrative details, to accept the company's offer. It is estimated that after making due allowance for depreciation, the value of the site, buildings, and equipment cannot be less than 100,000*l*. Some three acres of the site are covered by buildings, leaving four acres uncovered which have been available for recreative purposes. The annual endowment provided by the Goldsmiths' Company, originally fixed at 5000*l*. a year, has grown to about twice that sum. Following so soon upon Sir Donald Currie's splendid gift, of which particulars were given in the last issue of NATURE, there would really seem to be a new era opening for the University of London. It must not, however, be lost sight of that handsome as these two bequests are, they are alone quite inadequate to the great needs of a university equipped and staffed in a manner becoming to the University of London, the metropolis of the empire. It is greatly to be desired that the large minded generosity of Sir Donald Currie and of the Goldsmiths' Company will be immediately emulated by other wealthy individuals and corporations.

A BILL to amend the laws relating to education in Scotland, and for other purposes connected therewith, was introduced in the House of Commons on Monday by Mr. Graham Murray, and passed the first reading. The existing system in Scotland encourages the tendency of educational institutions to overlap, and leads to some waste of resources. In the field of primary education the School Boards have done excellent work, but for secondary and technical education the School Board area is too small. The area which has now been selected for educational purposes is the district area; but the great burghs, Edinburgh, Glasgow, Dundee, and Aberdeen, are to be dealt with exceptionally. There is to be a School Board elected for every district in a county. The number of members which each Board is to have will be fixed by the Scottish Education Department. The boards are to be public authorities for all branches of education, and they are to be elected on the county council franchise and the burgh franchise. In order to foster local interest in education every school is to have local managers, who, however, are not to be allowed to appoint or dismiss teachers or to borrow money. To private venture schools the boards are to be at liberty to give aid out of the rates, if they desire to do so; they are to be absolutely free agents in the matter. With regard to the financial proposals of the Bill, the various Imperial contributions are to be pooled; all the grants will go into one education fund. In order to remove some of the objections to the retention of the Scottish Department in London it is proposed that there shall be constituted by Order in Council four provincial councils which will meet in Edinburgh, Glasgow, Aberdeen, and Inverness. It will be the duty of these councils to deal with any matters referred to them by the department.

THE Military Education Division of the War Office has issued rules which will for the future regulate the appointment to commissions in the army. The rules will not apply to candidates for admission to the Royal Military Academy and Royal Military College until after the competitive examination of June, 1905. In order to show that they have attained a fair standard of general education, all

candidates for appointment to commissions will be required to obtain either a "leaving" certificate or a "qualifying" certificate. A "leaving" certificate is one including the same subjects as a qualifying certificate, and granted by a recognised body to candidates not less than seventeen years of age who have attended three years' continuous teaching, with satisfactory conduct, in a properly inspected school. A "qualifying" certificate is one covering two classes of subjects. All candidates must qualify in the subjects of class i., viz. English, English history and geography, and elementary mathematics. Candidates must qualify in two of the subjects of class ii., viz. science, French or German, Latin or Greek. The expression "science," the rules state, means so far as a leaving certificate is concerned, "such combination of experimental or natural science as the Army Council may approve, provided always that the sciences recognised shall have been taught in a sufficiently extended course, including a due amount of laboratory or field work." Any leaving certificate accepted must certify that the candidate has taken a sufficient course of elementary geometrical drawing and practical geometry, and also an elementary course of practical measurements. Leaving certificates will be accepted from the Oxford and Cambridge University examining bodies, the University of London, the Scottish Education Department, and such universities in Great Britain as undertake to issue a certificate satisfying the required conditions. The same bodies will hold examinations periodically at which candidates who desire to obtain qualifying certificates may present themselves.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, March 3.—"The Spectra of Antarian Stars in Relation to the Fluted Spectrum of Titanium." By A. **Fowler,** A.R.C.S., F.R.A.S.

The distinguishing feature of the spectra of the Antarian stars (Secchi's third type) is the system of apparently dark flutings, sharp towards the violet and fading off towards the red end of the spectrum. The principal flutings are well seen in Antares, but they are more strongly developed in the spectra of α Herculis and *o* Ceti, in which stars additional details are also seen. These flutings have not hitherto received a definite chemical interpretation, and it has been uncertain, owing to the possibly misleading effects of contrast, whether the spectrum was to be regarded as one consisting wholly of absorption flutings fading towards the red, or as one partly consisting of emission flutings fading in the opposite direction.

The purpose of the present communication is to state the nature of the evidence which indicates that the spectrum is essentially an absorption spectrum, and that the chief substance concerned in the production of the flutings is titanium, or possibly a compound of that element with oxygen.

The flutings in question come out in the arc spectrum of titanium oxide, if the precaution be taken to provide a liberal supply of material and to use a very long arc, taking care also that the image of the "flame" is projected on the slit of the spectroscope. They are also seen in the arc spectrum of the chloride under similar conditions. Numerous lines accompany the flutings produced in this manner, and some of the details are consequently masked or not recognised without careful study of the photographs. So far the flutings have not been very successfully produced in the oxyhydrogen flame; they are visible in the flame spectrum of the fumes from the chloride, but their observation is difficult on account of the bright continuous spectrum. The best representation of the flutings has been obtained by passing a spark, without jar, through the fumes of oxychloride which rise from the chloride of titanium on exposure to air. In these circumstances the lines which appear are not numerous, and some of the secondary flutings which are masked by lines in the spectrum of the flame of the arc are readily detected, in spite of the continuous spectrum which is also present.

The wave-lengths of the heads of the principal flutings are 6162·5, 5604·5, 5447·0, 5241·0, 5167·5, 4955·1, 4761·6 and 4584·3, and it is found that these agree within the possible limits of error with eight of the ten principal bands recorded in the stars by Vogel and Dunér.

The origin of the two outstanding bands at 5862 and 6493 has not yet been ascertained, but in the case of the remaining flutings the evidence for titanium is enormously strengthened by a discussion of their structure and by extending the comparison further into the violet. Photographs of the stellar spectra, especially those of *o* Ceti and α Herculis, show that some of the principal flutings are composite, Dunér's band 10, for example, containing, according to Sidgreaves, four distinct flutings separated by intervals of about 44 tenth-metres, each of which is weaker than the one which precedes it on the more refrangible side. A precisely similar structure is found in the case of the titanium flutings, and a comparison of wave-lengths indicates that the various components occupy the same positions as those in the stars, so far as the available measurements permit the test to be applied.

The table of wave-lengths given in the paper shows that the details of the titanium flutings are reproduced with remarkable fidelity in the stellar spectra, and more especially in *o* Ceti. There is some uncertainty in connection with the complicated groups of flutings and lines extending from 5598 to D, which need further investigation in the stellar spectra with instruments of greater dispersion, but the general agreement is such as to leave no reasonable doubt that titanium is the main factor in the production of the dark flutings which characterise the Antarian group of stars.

This explanation of the dark flutings suggests that the appearance of bright flutings in the Antarian spectrum arises chiefly from effects of contrast. It does not, of course, exclude the possibility of the presence of bright flutings, such as might be indicated by local brightenings which are not exactly in coincidence with the edges of dark flutings.

"An Inquiry into the Nature of the Relationship between Sun-spot Frequency and Terrestrial Magnetism." By C. **Chree,** Sc.D., LL.D., F.R.S.

(1) The formula

$$R = a + bS \quad (1),$$

where R is some magnetic quantity such as the amplitude of the diurnal oscillation of the needle, a and b constants, and S sun-spot frequency (after Wolf and Wolfer), was first applied by Wolf to the mean declination range throughout the year.

The present paper is entirely devoted to the connection between sun-spot frequency and terrestrial magnetism. It deals with data from Milan (1836–1901), Greenwich (1841–96), Pawlowsk and Katharinenburg (1890–1900), Batavia (1887–98), and Mauritius (1875–90). It aims at ascertaining wherein the results in my previous paper (*Phil. Trans.*, A, vol. ccii. p. 335) are peculiar to the station or period dealt with.

It investigates what differences may exist between the sun-spot connection on ordinary days and on magnetically quiet days, and what differences arise when one applies (1) to the mean of the differences between the absolutely highest and lowest daily readings, instead of to the range of the mean diurnal inequality. It also considers various measures of the magnetically disturbed character of the year, and their relation to sun-spot frequency.

There seems a general tendency for b/a to increase as we pass from a quantity, such as the range of a diurnal inequality, which is comparatively independent of disturbances, to a quantity such as the mean absolute daily range which is largely dependent on disturbances. Formula (1) becomes, however, less and less strictly applicable, the more disturbed the magnetic quantity to which it is applied. When we consider quantities such as the mean of the twelve monthly ranges (maximum and minimum for the month), or the annual range (maximum and minimum for the year), we find large differences between observed values and those calculated from (1).

In the case of ranges from mean diurnal inequalities for the year, the agreement between observed and calculated values is about equally good at Pawlowsk, Katharinenburg, Batavia, and Kew. In the case of declination, the mean difference between observed and calculated values is about

4 per cent. of the mean value of the range during the period dealt with. On the whole, the agreement is distinctly less good in the case of vertical force than in the case of declination, inclination or horizontal force.

March 17.—"On the Construction of some Mercury Standards of Resistance, with a Determination of the Temperature Coefficient of Resistance of Mercury." By F. E. **Smith**, A.R.C.Sc., Assistant at the National Physical Laboratory. Communicated by R. T. Glazebrook, M.A., F.R.S.

This paper contains an account of the construction and measurement of eleven mercury standards of resistance at the National Physical Laboratory.

A comparison between the international ohm as realised from these standards and the unit of resistance derived from the coils belonging to the British Association shows that

$$\left.\begin{array}{c}\text{Resistance of 1 int. ohm}\\ \text{(as realised at the N.P.L.)}\end{array}\right\} - \left\{\begin{array}{l}\text{Resistance of unit derived from}\\ \text{B.A. coils (assumed as equal}\\ \text{to } 10^9 \text{ C.G.S. units)}\end{array}\right. = 0.00008_3 \text{ ohm.}$$

A very concordant series of observations also indicates that

$$\left.\begin{array}{c}\text{Resistance of 1 int. ohm}\\ \text{(as realised at the Reichs-}\\ \text{anstalt)}\end{array}\right\} - \left\{\begin{array}{l}\text{Resistance of 1 int. ohm (as}\\ \text{realised at the N.P.L.)}\end{array}\right. = 0.00002_0 \text{ ohm.}$$

The methods adopted both for the construction and evaluation of the mercury standards are very different from those which have been previously employed, one of the methods of erection enabling the "end effect" of the tubes to be eliminated. Owing to the increasing accuracy of electrical measurements, it was thought desirable to realise the international ohm with a probable error not exceeding one part in one hundred thousand. The results obtained with the eleven mercury standards of resistance are in very close agreement, the calculated probable error of the determinations being ± 0.0008 per cent. only.

The temperature coefficients of resistance of (1) mercury in Jena $16'''$ glass, of (2) mercury in verre dur glass, and of (3) a constant volume of mercury, have also been determined for a range of temperature 0° C. to 22° C. The results are as follows:—

(1) Mercury in Jena $16'''$ glass,

$$R_T = R_0[1 + 0.0008801\text{8}T + 0.00000105793T^2].$$

(2) Mercury in verre dur glass,

$$R_T = R_0[1 + 0.00088036T + 0.00000103094T^2].$$

(3) A constant volume of mercury,

Deduced from (1),

$$R_T = R_0[1 + 0.00088788T + 0.0000010564T^2].$$

Deduced from (2),

$$R_T = R_0[1 + 0.00088776T + 0.0000010376T^2].$$

T being the temperature on the hydrogen scale.

"The Specific Heats of Metals and the Relation of Specific Heat to Atomic Weight. Part iii." By Prof. W. A. **Tilden**, F.R.S.

The object of the experiments, of which an account is given in this paper, was to determine whether the atomic heats of the elements entering into combination are preserved in the compound at all temperatures, previous results obtained by the author and others having shown that the specific heats of metals of small atomic weight, such as aluminium, increase very rapidly with rise of temperature.

As it is not possible to determine the specific heat of sulphur throughout a long range of temperature, tellurium was chosen for experiment. Compounds of tin, silver and nickel with tellurium were prepared, and two alloys of silver and aluminium. The average specific heats of all these elements, except tin, which melts at 232° C., were determined over various intervals from the boiling point of liquid oxygen to nearly 500° C. in the case of the less fusible elements, a range of about 680° C. From these mean specific heats the true specific heats at intervals of 100° C. absolute temperature were calculated, and from the specific heats the atomic heats were deduced. The mean specific heats of the compounds, formed by their union, were also determined, and from these data the molecular heats of the compounds calculated. On comparing the sum of the atomic heats of the elements present with the molecular heat of the compound at the successive temperatures, it was found that there is throughout a close concordance. The order of difference may be shown by one example:—

Nickel Telluride, NiTe.

Temperature, absolute	Sum of atomic heat of Ni and Te	Molecular heat of NiTe
100°	9·20	8·38
200°	11·08	11·35
300°	12 22	12·41
400°	13·00	12·92
500°	13·49	13·15
600°	13 85	13·28
700°	14·11	13·35

The results of these experiments show that Neumann's law is approximately true, not only at temperatures from 0° to 100° C., but at all temperatures. They thus support the view that the specific heat of a solid is determined by the nature of the atoms composing the physical molecules, and is not a measure of the work done in thermal expansion.

The paper concludes with a discussion of the relations of specific heat to atomic weight under different physical conditions, that is, in the solid, liquid and gaseous states.

Entomological Society, March 2.—Prof. E. B. Poulton, F.R.S., president, in the chair.—Commander J. J. **Walker**, R.N., exhibited (1) *Hecatesia fenestrata*, Bdv., an interesting Australian moth, the ♂ possessed of a very marked power of stridulation (stridulating organ on longitudinal transparent bar on fore-wing), known in New South Wales as the "whistling moth"; (2) *Dodonidia helmsi*, Butler, a rare satyrid butterfly from New Zealand; and (3) a gigantic species of the Thysanurid genus Japyx, found at Picton, New Zealand.—Mr. C. O. **Waterhouse** exhibited and commented upon a diagram of the mouth of one of the Mallophaga (*Laemobothrium titan*).—Mr. G. C. **Champion** exhibited specimens of the two species of Dorcadion found during his recent journey in Spain, *D. almarzense*, Esc.? from the summit of Montcayo, and *D. neilense*, Esc., from the Sierra de Logroño. He also exhibited numerous examples of *Pyropsyche moncaunella*, Chapm., found by Dr. Chapman and himself on Montcayo.—Mr. A. J. **Chitty**, Mr. **Jennings** and other fellows exhibited specimens of the genus Tropiphorous to determine if possible whether *T. tomentosus* and *T. obtusus* were in reality one and the same species. Various cases of coincident localities for the species were quoted, and it was the general opinion that in the United Kingdom the two were but forms of one species.—Dr. F. A. **Dixey** read a note on the so-called "bugong" moth consumed by some Australian natives for food. He said it was not a Euplœa at all, as supposed by Kirby in his "Bridgwater Treatise," but a Euxoa, and not a butterfly as also stated by Westwood.—The **President** exhibited a specimen of a beetle, *Glenea pulchella* (Thoms.), one of three individuals of the species taken in the Nilgiris by Mr. Leslie Andrewes, which clearly mimics a large ichneumon fly not yet identified.—Mr. L. B. **Prout** exhibited, on behalf of Mr. A. Bacot, long bred series of *Triphaena comes*, Hb., the result of breeding for two generations from a wild ♀ of the *curtisii* form, taken near Forres. In the first generation, rather more than half the progeny followed, to a certain extent, the parent ♀, though varying from rich deep red to almost black. Pairings of these dark specimens resulted in a brood in which the percentage of ab. *curtisii* was slightly increased, although the type forms were still well represented; but it was noticeable that in every specimen the orbicular stigma was filled up with the darker or melanic colour.—*Papers*:—Notes on Australian and Tasmanian Cryptocephalides, with descriptions of new species: A. M. **Lea**.—A revision of the subfamily Pelidnotinæ of the coleopterous family Rutelidæ, with descriptions of new genera and species, by the late F. **Bates**.—On some new species of eastern Australian and African moths in the British Museum: Colonel Charles **Swinhoe**.—An entomological excursion to Montcayo, Spain, with some remarks on the

habits of *Xyleborus dispar*, Fabr., by Dr. Thomas Algernon Chapman: G. C. **Champion.**—Further notes on Hydroptilidæ belonging to the European fauna, with descriptions of new species: K. J. **Morton.**—A note on *Elymnias borniensis*, Wallace: R. **Shelford.**—A discussion on "What is a Species?" was opened by the Rev. F. D. Morice, in which Mr. H. J. Elwes, Prof. F. A. Dixey, Mr. A. J. Chitty, Mr. W. E. Sharp, the president, and other fellows joined.

Geological Society, March 9.—Dr. J. E. M. F.R.S., president, in the chair.—On the probable occurrence of an Eocene outlier off the Cornish Coast: Clement **Reid,** F.R.S., communicated by permission of the director of H.M. Geological Survey. The evidence suggests that, underlying the western part of the English Channel, an Eocene basin may occur comparable in importance with that of Hampshire.—The Valley of the Teign: A. J. **Jukes-Browne.** The Teign Valley is not a transverse valley preserving a general direction in spite of opposing ridges, nor is it a longitudinal valley running parallel to a dominant ridge, nor is it a simple combination of one with the other, as often happens; but it apparently consists of parts of two transverse valleys linked by a longitudinal one. The Teign runs off Dartmoor through a gorge which takes an easterly direction, as if it were going to join the Exe; it is then deflected southward into what, with respect to the Permian escarpment, is a longitudinal valley; this ends in a low-lying plain, and from this plain it escapes eastward to the sea through a transverse valley, which has been cut across the ridge of Permian and Cretaceous rocks. The theory of the capture of one river by another furnishes an intelligible explanation of the facts when applied to the course of the Teign. The author thinks that some other river-courses and geographical features in Devon can be explained on the theory of an easterly incline modified by a subsequent southerly tilt.

Physical Society, March 11.—Dr. R. T. Glazebrook, F.R.S., president, in the chair.—The whirling and transverse vibrations of shafts: Dr. **Chree.** The paper shows how the mathematical results obtained by Prof. Dunkerley can be derived by a less cumbrous treatment, and how in many instances they admit of great simplification, without sensible loss of accuracy. It is also shown how loaded shafts can be dealt with, without recourse to the hypothesis presented by Dunkerley; at the same time some light is thrown on the relation of this hypothesis to theory. Six main cases are considered, in which the shaft is variously supported; in some of them numerical results are deduced for comparison with Dunkerley's experiments.—Notes on non-homocentric pencils, and the shadows produced by them, part ii., shadows produced by axially symmetrical pencils possessing spherical aberration: W. **Bennett.** This paper deals with the shadows obtained by interposing a straight wire near the focus of a pencil proceeding from a lens or mirror uncorrected for spherical aberration. A method is described for drawing sections of the wave-front in the neighbourhood of the focus. A simple physical explanation of the shadows is given by means of the wave-fronts; it is shown that the real shadow consists in general of two branches, one closed and the other open, with a ϕ-form as a symmetrical special case. The equations of the wave-front are worked out for the special case of the reflection of a plane wave at a spherical mirror, and a method of drawing the shadow-forms is described.

Linnean Society, March 17.—Prof. J. Bretland Farmer, F.R.S., vice-president, in the chair.—An account of the Bryozoa from Franz-Josef Land, collected by the Jackson-Harmsworth Expedition, 1896, 1897 (part ii., Cyclostomata, Ctenostomata, and Endoprocta): A. W. **Waters.** Mr. Waters comments on the confusion that has arisen from attempts to base a classification of the Cyclostomata on almost valueless characters taken from fossils. The bipolar theory of distribution, in his opinion, receives little support from the Bryozoa, in several instances species that are distinct having been united, and in the comparison of opposite areas the terms Arctic and Antarctic not having been used with similar strictness.—Botanic illustration from the fifteenth to the twentieth centuries: B. Daydon **Jackson.**

CAMBRIDGE.

Philosophical Society, February 29.—Dr. Baker, president, in the chair.—On decomposition of hydrogen dioxide under the influence of radium bromide: H. J. H. **Fenton.** These experiments were originally undertaken with the object of studying the conditions of stability in aqueous solutions of pure hydrogen dioxide at the ordinary temperature in absence of light. The observations have been extended so as to include an investigation of the influence exerted by rays from the latter substance on the decomposition of the dioxide. It has been shown by Bredig and his colleagues that the rate of decomposition of hydrogen dioxide under the influence of catalysers, such as colloidal platinum, and in presence of many electrolytes and non-electrolytes, follows the law for a reaction of the first order; in the case of the pure dioxide alone, however, under the influence of platinum, the change is not strictly in accordance with this law, the value of the constant increasing as the concentration of the dioxide becomes smaller. Similar results are obtained in the present instance when the aqueous solution undergoes decomposition either alone or under the influence of radium rays. In the latter case, however, the change is greatly accelerated, the value of the constant in each case being approximately double that calculated from the parallel blank experiment. Further experiments are in progress with the object of ascertaining whether the oxidation of organic substances, either alone or in presence of iron, is influenced by radium.—Exhibition of oribatid mites taken in the neighbourhood of Cambridge: C. **Warburton** and N. D. F. **Pearce.** The Acari have received little attention in this country, and this is the first attempt to investigate the local fauna of any acarine group. In four winter months specimens of forty-seven out of the hundred known British species have been taken in the neighbourhood of Cambridge, and every one of the fifteen British genera is locally represented.—Some observations on the determination of sex in plants: R. P. **Gregory.** The work was carried on in response to Castle's suggestion that sex may be a character inherited in accordance with the Mendelian principles of segregation and dominance. The problem is rendered more complex in plants owing to the occurrence of two distinct generations (the sporophyte and the gametophyte) which regularly alternate in the life-history of the plant. In the flowering plants the alternation is masked by the complete dependence of the gametophyte upon the sporophyte; but in the ferns this is not the case; this group was therefore chosen as the subject for investigation. From the observations it appears that sex in the sporophyte is homologous with that in animals, and may perhaps be inherited in accordance with Mendelian principles. It is to be distinguished from sex (as manifested by the production of antherozoids or of ova) in the gametophyte, the latter being determined by the conditions of nutrition.—On variation in the number and arrangement of the male genital apertures, and on the relative proportion of the sexes, in the Norway lobster (*Nephrops norvegicus*): D. C. **McIntosh.** The results are given of an examination of 656 specimens obtained from the Firth of Clyde. The percentage having an abnormal number of genital apertures was 2·49, or considerably lower than that recorded by Marshall for the Norway lobsters from the Firth of Forth. Among the Clyde specimens the sexes occurred in approximately equal proportions, the females on an average being of considerably smaller size than the males.—On the boiling points of homologous compounds: H. **Ramage.** The relation of boiling point to molecular weight has been studied by means of diagrams drawn with the former as abscissæ and the latter as ordinates. These indicate that Walker's formula for the ten paraffins C_7H_{16} to $C_{16}H_{34}$ only applies to the CH_2 linkage in the molecules, and that the influence of the terminal hydrogen atoms is either a constant in these higher members of the series or it is so small it may be disregarded. The influence of the terminal atoms increases as the chain shortens, and Walker's formula does not, on this account, apply to the lower members. This view has led to a modification which includes all the series up to $C_{16}H_{34}$. The new formula is $T = a\{M(1-2^{-n})\}^{\frac{1}{2}}$, in which T is the boiling point in absolute degrees, a is a number depending on the pressure, M is the molecular weight, and n the number of carbon atoms in the molecule.

PARIS.

Academy of Sciences, March 21.—M. Mascart in the chair.—On hypoabelian groups: Camille **Jordan**.—New researches on the density of fluorine: Henri **Moissan** (see p. 520).—On an African trypanosome, pathogenic for horses: A. **Laveran** and F. **Mesnil**. In the course of their researches on human trypanosomiasis, Messrs. Dutton and Todd have discovered a new trypanosome which is pathogenic to horses, and to which they give the name of *Tr. dimorphon*. A comparison of this trypanosome with *Tr. gambiense* shows that the two species are morphologically distinct. That they are distinct species is also shown by the fact that animals which have acquired immunity for *Tr. gambiense* are still sensible to *Tr. dimorphon*; human serum, which is without action upon *Tr. gambiense*, has a feeble but distinct action upon the other species. The general conclusions of Dutton and Todd are confirmed.—On some formulæ useful in discussing the stability of a vitreous medium: P. **Duhem**.—On the general conditions and unity of formation of combustible minerals of all ages and of all species: M. **Grand'Eury**. The author regards all Coal-measures, of whatever epoch, as being formed under water in a similar manner by the débris of marshy vegetation. On forms decomposable into linear factors: F. **Hocevar**.—The law of disappearance of the activity induced by radium after heating the substances rendered active: P. **Curie** and J. **Danne**. Plates of platinum, which had been exposed for some time to the action of radium, were heated to different temperatures, and the rate of loss of activity studied at the room temperature. The curves, taking time as the abscissæ and the logarithm of the intensity of radiation as the ordinates, become linear at the higher temperatures.—The study and comparison of the methods of reduction of magnetic hysteresis: Ch. **Moureu**. The hysteresis may be suppressed by the action of an oscillating magnetic field.—The action of magnetism on phosphorescence: Alex. **de Hemptinne**. All phosphorescent substances do not appear to be equally susceptible to the action of a magnetic field.—The application of the electric spark to the chronophotography of rapid movements: Lucien **Bull**. An instrument is described which is capable of taking 1500 images per second.—The study of colloidal solutions: Victor **Henri** and André **Mayer**. It has been generally held that the phase rule cannot serve as a guide in the case of colloidal solutions. The author holds that the phase rule may be applied to the systematic study of the precipitation of colloids whenever the phenomena of precipitation are reversible.—The transformation of oxides and oxygenated salts into chlorides: C. **Matignon** and F. **Bourion**. Further applications are given of the use of a mixture of chlorine and sulphur chloride in the preparation of anhydrous chlorides. The substances studied include tungstic acid, chromic and ferric oxides, the oxides of nickel and cobalt, zinc, manganese and tin, boric anhydride and the sulphates of barium and calcium. In the last two cases the transformation is so complete that the reaction may serve as the basis of a quantitative method.—The lead and silver salts of the monoalkylphosphoric acids: J. **Cavalier**.—Arnisterine, the phytosterine of *Arnica montana*: T. **Klobb**.—On some aminoalcohols with alcoholic function of the type $R.C(OH)(CH_3).CH_2.N(CH_3)_2$: E. **Fourneau**.—*Hyphoene coriacea*, the textile palm of Madagascar: Pascal **Claverie**. On the persistence of alternate structure in some Labiates: G. **Chauveaud**.—Specific action of some parts of the body on certain phosphorescent screens: Augustin **Charpentier**.—On the colour reactions resulting from the action of tyrosinase: C. **Gessard**.—On the presence of an apparatus for accommodation in the compound eyes of certain insects: Pierre **Vigier**. Proofs are given of the existence in the compound eyes of Aeschna of a real accommodation apparatus, allowing of the adaptation of the sight to different distances.—Study of the law of action of maltase. The influence of the concentration of the maltose: E. F. **Terroine**. The influence of the concentration of the maltose is similar to the cases of invertine, emulsin, amylase and trypsin.—Studies on the action of maltase. The constancy of the ferment: Mlle. Ch. **Philoche**. When maltase from Taka diastase is allowed to act at 40° C. the activity of the ferment undergoes no appreciable change in the first twenty-four hours.—On the duration of the treatment of arterial hypertension in arteriosclerosis by d'Arsonvalisation: A. **Moutier**. Under appropriate diet, the arterial tension in patients suffering from arteriosclerosis can be rapidly reduced to the normal by the use of high frequency currents.—The action of metals in the colloidal state and of artificial oxidases on the evolution of infectious diseases: Albert **Robin** and G. **Bardet**.—The action of formic acid on the muscular system: E. **Clement**. Sodium formate increases the muscular power and also the resistance to fatigue to a marked extent.—The fusion of ice by electricity, and the application of this principle to navigation in Arctic seas: F. Romanet **du Caillaud**.

DIARY OF SOCIETIES.

TUESDAY, APRIL 5.

NATIONAL ASSOCIATION OF MANUAL TRAINING TEACHERS.—Annual Conference at Hastings, at 3.—The Psychological Importance of Manual Training: Sir John Cockburn.

THURSDAY, APRIL 7.

LINNEAN SOCIETY, at 8.—The Morphology and Anatomy of the Stem of the Genus Lycopodium: C. E. Jones.

RÖNTGEN SOCIETY, at 8.30.—Exhibition Evening.

FRIDAY, APRIL 8.

GEOLOGISTS' ASSOCIATION, at 8.—On the Metamorphism of Sediments: G. Barrow.

MALACOLOGICAL SOCIETY, at 8.—Description of apparently New Species of Corbicula, Melania, Vivipara and Lagochilus from Java: Rev. R. Ashington Bullen.—The Hawaiian species of Opeas: E. R. Sykes.—On some Non-marine Hawaiian Mollusca: C. F. Ancey.—Description of a New Species of Ancilla from New Zealand: Rev. W. H. Webster.—Report on a Small Collection of Helicoids from British New Guinea, with Description of a New Species: G. K. Gude.

ROYAL ASTRONOMICAL SOCIETY, at 5.

CONTENTS.

THURSDAY, APRIL 7, 1904.

COLOURING MATTERS, ARTIFICIAL AND NATURAL.

A Systematic Survey of the Organic Colouring Matters. Founded on the German of Drs. G. Schultz and P. Julius. By Arthur G. Green, F.I.C., &c., Professor of Tinctorial Chemistry at the Yorkshire College, Leeds. Second edition. Pp. x+280. (London: Macmillan and Co., Ltd., 1904.) Price 21s. net.

APART from its special value to experts as a standard work of reference, the present compilation is of general interest as enabling chemists to gauge the progress in a department of industry which is perhaps more intimately associated with scientific research than any branch of manufacture that has been called into existence as the result of laboratory work. The first English edition bears the date 1894, and it was noticed in these columns at the time of its appearance (vol. l. p. 267). The present edition, therefore, enables us to measure the development which has taken place during the last decade. First, with respect to the actual number of coal-tar colouring matters on the market. The edition of 1894 enumerated 454 distinct compounds; the present edition comprises 695; an apparent addition of 241 definite organic products of tinctorial value in ten years is an instructive illustration of the resources of chemical science when these are requisitioned in the service of industry. The actual number of new products is, however, even greater than this, since 59 dyestuffs which were included in the last edition have been removed from the list as being obsolete. The total number of new colouring matters is thus 300, so that the increment has been taking place at the rate of 30 per annum.

A more detailed analysis of the tables will also serve to bring out the new departures which have been made, and which are, in part at least, responsible for the large number of new products added to the list. Thus in 1894 artificial indigo was entered as "not in commerce," although the fundamental process which has since been developed with such marked success in Germany was known at that time, and the references to Heumann's paper and the first patents of the Badische Company are included in the literature. In the present edition five processes for preparing synthetic indigo are tabulated, and five new products derived from or related to indigo are added to the tables as the outcome of the industrial development of the chemistry of this group of colouring matters.

In the great domain of the azo-colours, the development is quite astonishing. From 234 recorded in the last edition, the number has now reached 383, grouped into 125 monazo, 203 disazo, 45 trisazo, and 10 tetrakisazo compounds. The first representative of the group of colouring matters now known as the oxazines was discovered by the writer of this notice in 1879. In 1894 thirteen compounds belonging to this group were recorded as technical products; in the present edition 31 oxazines are in the tables. The first member of the sulphur-containing compounds, known as the thiazol or thiobenzenyl colouring matters, was discovered and introduced into commerce in 1887 by Prof. Green under the name of "primuline." The monopoly conferred by the right of discovery of this important compound was lost to the firm in the laboratory of which the discovery was made by the adoption of the short-sighted policy that a new product could be protected as a "trade secret." Within a year of its introduction the Germans had found out its chemical constitution and were manufacturing it, and a German firm actually obtained patents for producing it in this country as well as in Germany. Those who are now bidding for notoriety by directing public attention to the ways in which British industries have been lost may draw some very instructive conclusions from the consideration of this little chapter in the history of industrial chemistry.

Another very striking development, familiar, of course, to tinctorial chemists, and brought out conspicuously by a comparison of the two editions of the present work, is to be found in the group of sulphide colouring matters. In 1873 the French manufacturers introduced under the name of "Cachou de Laval" a brown dyestuff prepared by fusing sawdust, bran, &c., with sodium sulphide. This figures in the 1894 edition as the only compound of its class. The action of fused sulphides upon definite organic compounds of known constitution has led since 1894 to the introduction of no less than 20 new colouring matters, into the composition of which sulphur enters as an integral constituent of the molecule. Some of these compounds are black dyestuffs of great value on account of their fastness. They are, moreover, of particular scientific interest as offering a new field of research in connection with the question of the constitution of what may perhaps prove to be thiocyclic compounds. With the exception of the "immedial sky blue" of Messrs. Cassella and Co., for which a probable formula is given, not one of these new compounds has even an empirical formula assigned to it. We have here, in fact, another illustration of the well-known principle that technology is often in advance of pure science.

In many other directions can the industrial and scientific development of this great branch of chemical technology be traced in the pages of the present work. The raw and intermediate products of which the translator and editor gave an account in the English edition numbered about 243 and occupied fifty-seven pages of the first edition. In the present edition some 60 new intermediate products have been introduced, and their description extends to more than seventy pages. Neither must the theoretical developments be overlooked in connection with an industry which is so intimately associated with the advancement of our knowledge of the chemical constitution of organic compounds. Evidence of this advancement is to be found throughout the tables before us, one of the results being a more detailed and perfect classification of the groups of colouring matters and the transference of many compounds of which the constitution was formerly unknown to definite places under their group type. It is of interest to note also in passing that the

quadrivalent character of the oxygen atom, which received such remarkable confirmation a few years ago through the researches of Prof. Norman Collie and his colleagues, now finds definite expression in the formulæ of the oxazines and certain other colouring matters.

In two respects the present edition differs from its predecessor. The tables for the qualitative examination of colouring matters have been omitted, and in their place a section on the natural dyestuffs has been added at the end of the tables of artificial colouring matters. This new section is of interest from many points of view. It serves, in the first place, to remind us that natural dyestuffs have not yet been entirely superseded by synthetical coal-tar products. It also brings out the fact that with respect to the chemistry of these vegetable colouring matters pure science is in advance of technology, inasmuch as the constitutional formula of the majority of these compounds has been determined with more or less probability. With the exception, however, of luteolin, the colouring matter of weld, which has been synthesised by Kostanecki and his colleagues, none of the products entered in this last table have been produced by laboratory processes. Such important colouring matters and dyestuffs as hæmatoxylin from logwood, brazilin from Brazil wood, quercetin from quercitron, and rhamnetin from Persian berries have for many years been undergoing investigation here and abroad, and some or all of these may have to be transferred to the tables of artificial products by the time this work reaches a new edition. Supposing such syntheses to be accomplished, the struggle between the synthetical and the natural products will no doubt furnish the industrial world with further material for serious reflection. Whether the result of the artificial production of these outstanding members of a group which supplied the world with dyestuffs before the discovery of the coal-tar products will be the same as that which followed the synthesis of alizarin, and threatens to follow the synthesis of indigo, it would be extremely rash to predict.

The usual considerations respecting the loss of the coal-tar colour industry to this country cannot but arise in looking through the present series of tables. The enormous development to which attention has been directed in this notice is almost entirely due to German discoveries. The hundreds of patents referred to in the bibliographical columns are German by an overwhelming majority. The causes of this decadence of what was originally a British industry have been so frequently discussed that it would appear that nothing further is to be gained by their reiteration. Of late years, however, two subordinate causes of this decline have been thrust upon public notice with such vehemence that the uninitiated may be led to believe that the "imperfection of our patent laws" and the want of "duty free spirit" have together wrecked manufacturing enterprise in this direction. The present writer is glad of this opportunity of expressing dissent from these statements. An amendment of our patent laws is certainly desirable, and duty free spirit would unquestionably be a boon for certain branches of manufacture. But to exalt these, which may be called minor deterrents, into the rank of a complete explanation of British failure and German success is simply dragging the proverbial red herring across the trail.

No further commendation of the well-known work which has led to these reflections is necessary than the statement that it is as indispensable as its predecessor to all who are in any way concerned in this branch of chemistry and of chemical technology.

R. Meldola.

THE MALAY FAUNA.

Fasciculi Malayenses. Results of an Expedition undertaken by N. Annandale and H. C. Robinson. Zoology. Parts i., ii. and Supplement. By various authors. (London: Longmans, Green and Co., 1903.)

Of late years, mainly owing to the labours of Captain Stanley Flower and to the collections made by the *Skeat* Expedition (of which, by the way, Mr. Annandale was a member), very considerable advances have been made in our knowledge of the vertebrate fauna of the Malay countries. So large, indeed, was the amount of new information thus acquired that it might have been supposed little more remained to be accomplished. If such an idea were ever seriously entertained, it is, however, at once disposed of by the work before us, which, as stated on the title-page, is intended, when complete, to give a full account of the anthropological and zoological results of an expedition to Perak and the Siamese Malay States undertaken during the years 1901 and 1902 by Messrs. Annandale and Robinson, under the auspices of the Universities of Edinburgh and Liverpool. That the wise liberality of these two bodies has been amply justified is fully demonstrated by the present parts, which form only a foretaste of what is to come.

In the introductory note to the mammals, Mr. Robinson states that he was not so successful in the capture of these creatures as he had hoped to be, and that, in his opinion, there are many new small forms yet to be discovered. Nevertheless, Mr. J. L. Bonhote, to whom this section of the work has been entrusted, announces the discovery of eight new species. Among these, the most interesting are, perhaps, a cat and a squirrel respectively allied to *Felis badia* and *Sciurus lowei* of Borneo, and thus indicating a close relation between the faunas of that island and the Malay Peninsula. Not less important is the identification of the Malay porcupine with the *Histrix grotei* of Gray, hitherto known solely by one young example.

Of even greater interest is the series of reptiles and amphibians, which is described by Mr. G. A. Boulenger. In collecting reptiles for the *Skeat* Expedition, Mr. Annandale paid special attention to snakes; on the second occasion his attentions were mainly devoted to lizards; consequently the two collections are complementary. Mr. Boulenger describes as new two frogs, as many tortoises, a lizard and a snake, while he adds one snake and three lizards to the fauna of the Malay Peninsula. The new tortoise (*Testudo pseudemys*) is a near relative of the Burmese brown tortoise (*T. emys*), an isolated species, with the limbs enveloped in a complete bony panoply, which also ranges into the peninsula. In regard to frogs, the most interesting observations are by Mr. Annan-

dale, who states that there is no support whatever to the story told by a Chinaman to Dr. Wallace as to the flying powers of *Rhacophorus nigropalmatus*, or a closely allied form. Consequently, it may be hoped that the fable of the flying frog will disappear from zoological literature but errors of this sort die hard. Mr. Annandale notices that certain kinds of Malay reptiles are much more brilliantly coloured in the immature than in the adult condition, and likewise records that the giant cobra (*Naia bungarus*) is the object of mimicry by a harmless snake of the genus Zamenis, typified by the Indian rat-snake.

Of the invertebrates included in the first section Colonel Swinhoe treats of the moths, and shows in the course of his descriptions that these insects do not display that division into a lowland and a mountain type so noticeable in the case of the birds. Land-planarians, of which one out of the three specimens procured indicates a new species, are described by Mr. F. F. Laidlaw. The six species of parasitic Diptera collected—the first recorded from Malacca—are discussed by Dr. Speiser. Tiger-beetles are treated of by Mr. H. C. Robinson. Finally, dragon-flies fall to the lot of Mr. Laidlaw, who tells us that in respect of these insects the fauna of the Malay Peninsula, as contrasted with its Burmese representative, is much more closely related to that of Sumatra.

Part ii. includes seven articles (together with an appendix), of which the first four are devoted to invertebrates. Mr. W. E. Collinge describes the land molluscs, among which the discovery of one remarkable Bornean genus in the Malay Peninsula is of considerable interest. Rhynchota, of which only a portion of the collection is described, fall to the lot of Mr. W. L. Distant, who records several new forms, illustrated in a coloured plate. Dr. D. Sharp contributes an interesting account of the remarkable and gigantic insects of the genus Helicopris. In the vertebrate section, Mr. G. A. Boulenger contributes a list of the freshwater fishes; while Mr. J. Johnston reports on the marine representatives of that group. Especially interesting is a species of mud-skipper of the genus Periophthalmus described by the latter gentleman as new, owing to a marked difference in its habits from other species. Finally, Dr. C. W. Andrews contributes a note on a tooth of *Elephas namadicus*, in the course of which he makes the apparently incorrect statement that the species in question occurs in the Upper Siwaliks, whereas it is confined, in India, to the gravels of the Narbada Valley.

While fully appreciating the manner in which this section of the work has been carried out, we may suggest that it would much facilitate reference if in future, instead of the serial title appearing in the head-lines of both pages of the text, the titles of the different articles were given on the right-hand pages.

In the supplement Messrs. Annandale and Robinson furnish, in the form of an itinerary, a brief general account of the districts visited, which cannot fail to be of great value to future travellers. In addition to several photographs of scenery, it contains an excellent coloured map of the middle portion of the Malay Peninsula.

R. L.

FIRM FOUNDATIONS.

Vorlesungen über projektive Geometrie. By Prof. F. Enriques. Deutsche Ausgabe von Dr. H. Fleischer. Pp. xiv + 374. (Leipzig: Teubner, 1903.)

Encyklopädie der Elementar-Mathematik. Von H. Weber und J. Wellstein. Erster Band. Elementare Algebra und Analysis. Von H. Weber. Pp. 447. (Leipzig: Teubner, 1903.) Price 8 marks.

THE fact that Prof. Enriques's book has been translated from the original Italian into German at the instigation of Prof. Klein argues much for both its intrinsic merit and its widespread reception; for it is designed to fall within the scope of readers to whom the foreign language presents a greater difficulty than the subject-matter. The warm praise bestowed by Prof. Klein in his introductory notice renders criticism superfluous. He says, "ich kenne keines (Werk), welches den systematischen Aufbau dieser Disziplin in einer dem heutigen Stande der Wissenschaft entsprechenden Form in so durchsichtiger und gleichzeitig so vollständiger Weise darböte, wie das vorliegende. Dabei ist die Darstellung überall anschaulich und doch völlig streng. . ."

Probably the best known book on the subject is Reye's "Geometrie der Lage," and in the region where the two overlap the present volume is, speaking personally, much more readable. Reye, however, includes a large amount of solid geometry, reaching even Kummer's surface by synthetic methods, whereas Enriques devotes all but one chapter to plane geometry. He makes continual appeal to intuition, but at the same time skilfully bases his system on rigorous logical deductions from six axioms, without becoming tedious. Of the axioms, three deal with incidence, two with order, and the last is Dedekind's axiom of continuity.

Since cross ratio occupies so large a portion of the book, it is unfortunate that the notation is rather confusing; the elements should be named in the order in which they would actually occur if the range were harmonic. There is great practical convenience in doing this, and it is customary at least in this country.

An interesting feature of the book is the chapter on constructions with certain instruments. It is shown that all metrical problems of the first degree are soluble with the aid of a ruler when a square is given, and all problems soluble with ruler and compasses are soluble with a two-edged ruler alone. Certain problems of the third degree appear here for the first time in a text-book.

The volume concludes with a short historical account, which has been increased in the German edition.

The title of the series of three volumes by Herren Weber and Wellstein is possibly appropriate, but certainly misleading, as it suggests a comparison with the great "Encyklopädie der mathematischen Wissenschaften" which is in course of publication by the same firm; whereas there is no similarity, and the present work is written more from a pedagogic point of view than with the intention of supplying an exhaustive work of reference. One can imagine the

book to be the outcome of a course of lectures to graduates intending to enter the teaching profession, in which Prof. Weber brings his long years' experience and profound knowledge to bear upon some of the subjects usually regarded as "elementary."

The first volume contains three parts, Grundlagen der Arithmetik, Algebra, Analysis. The remaining two volumes are to deal with geometry, and applications. The contents are what every teacher of elementary mathematics should know and not teach. The authors have found some difficulty in defining the range of subjects of discussion, but no limitation has been imposed upon the methods employed. The first few pages deal with aggregates, and later we come to the logical reasoning upon which the introduction of irrationals and of imaginaries is based. The part on algebra is chiefly concerned with theory of equations and theory of numbers, and the third part with infinite series and products, including the most important examples. Speaking generally, subjects of technical or practical interest are excluded, and only those presenting serious logical difficulties are discussed in detail.

The book is admirably printed and clearly arranged, and should prove a very useful and trustworthy companion to all who care for exact knowledge for its own sake.

R. W. H. T. H.

OUR BOOK SHELF.

Stars and Sextants. By Sprigge, Doak, Hudson and Cox. With an introduction by Lord Ellenborough. Pp. xxv+55. (London: J. D. Potter, 1903.) Price 2*s.* 6*d.*

This book places in the hands of explorers, navigators, surveyors and others who use the sextant a simple means of finding its centring error. The centring error of a sextant at sea has hitherto been severely left alone on account of the somewhat tedious calculations necessary to find it.

The method of obtaining the total error (and hence the centring error by applying the index error) by observing the distance between two stars when on the same vertical circle is mentioned in "Hydrographical Surveying," by Sir William J. L. Wharton, in the second edition, 1898. The error thus obtained is owing to refraction not strictly accurate, unless the two stars are of equal altitudes at the time of observing. The best time for observing the distance between two stars, so that refraction may have the least possible effect and alter slowest with the time, is when the altitudes of the stars are equal. However, the error due to refraction in observing stars at different altitudes is not great when they are on the same vertical circle, and in finding the error of a sextant at sea it may be neglected, especially if the altitude of the lower star be above 30 degrees.

The centring error can only be found for different points on the arc of a sextant by taking a large number of observations for each point and meaning the results. It is to be hoped this book will induce many to take these observations, so that while learning the principal stars they may also become expert observers.

The book contains (1) ephemeris, 1904, with star pairs of nearly equal magnitude; (2) distances of star pairs; (3) ex-meridian star pairs, with distances for every ten days; (4) semi-diurnal arcs for finding the time a fictitious star rises and sets; (5) astronomical refraction corrected for barometer and thermometer; (6) notes on the stars. The descriptions and rules for using the tables are clear and simple, the figures are well arranged, and the type is very distinct. The temperature required for correcting the refraction should be taken by a Fahrenheit thermometer in a screen exposed to the open air.

This book might lead a tyro to suppose that correct time for obtaining errors and rating chronometers can only be obtained by equal altitudes of the sun, and only by a sextant of which the centring error is known; such is not the case. Time can be accurately obtained with a faulty sextant by observing sets of single altitudes both A.M. and P.M. of the sun, of stars both east and west of the meridian and meaning the results. By another less known but very valuable method the time is obtained in less than half an hour, if the stars are properly selected, by taking the equal altitudes of two different stars on opposite sides of the meridian.

Nothing must prevent the navigator from finding his position by stars. Take them at other times when possible, but *always* at twilight.

Vansittart Howard.

Engine Tests and Boiler Efficiencies. By J. Buchetti. Pp. xv+255. (Westminster: Constable and Co., Ltd., 1903.) Price 10*s.* 6*d.* net.

The volume before us is a translation, by Mr. Alexander Russell, of M. Buchetti's well-known work "Guide pour l'Essai des Moteurs." The object of the volume is to place before British and American engineers a record of Continental practice so as to render a comparison possible with home practice, and in order to further this comparison the measures and tables have been converted to English units.

The subject-matter is divided into nine chapters, and commences with well illustrated descriptions of the many indicators in use for testing steam and other engines. The important subject of mounting the indicator is then thoroughly dealt with, and this is as it should be, since the accuracy of the results depends entirely on the fitting and the scientific arrangement of the gear; M. Buchetti appears to have taken infinite pains to treat these details very thoroughly—there are many evidences of this right through the book.

The same can be said of the treatment of the several types of brakes now in use. When dealing with properties of steam, we note on p. 180 one or two clerical errors under the paragraph on saturated steam. The author talks about "If we compress the piston," &c., and further on in the next paragraph he says, "When the piston is allowed to expand"; surely the word piston should read "saturated steam" or "steam"?

The brief chapter on the testing of steam turbines by the Hon. C. A. Parsons, F.R.S., is all too short; we should have welcomed more interesting details from the pen of this able experimenter and engineer.

Taken as a whole, however, this book is full of interest. Students of steam and engineering should lose no time in obtaining a copy, since its contents are of the highest value to them.

N. J. L.

An English Grammar. By the Rev. S. Claude Tickell, A.K.C. Pp. 60. (London: O. Newmann and Co.) Price 2*s.*

This pamphlet of sixty pages is very unlike what is ordinarily understood by an English grammar. It opens with a paragraph of three lines headed "Analysis and Parsing Differentiated." Then comes

a fearfully intricate-looking table with the heading "(I.) Analysis by Triple Formula and Genealogy. (A) Analysis into Words." To the meaning of "triple formula" we find no clue but such as may be contained in the statement of the preface that "Analysis resolves itself into Limitation, Limiting Capacity, and Modification to denote Limiting Capacity." The table, which fills three pages, should, the author says, be learnt by heart. Further on there are two other similar tables, headed "(B) Analysis into Sentences and Clauses," and "(II.) Parsing." The "analysis into words" is exemplified by a number of specimens, in which the words forming the sentence are arranged in a diagram resembling a genealogical tree. The "analysis into sentences and clauses" is also performed by means of diagrams, but of a different kind. We must confess that the first impression we received on turning over the pages was one of utter bewilderment. After a while, however, we began to see that the author had a meaning, and for the most part a reasonable meaning, though his mode of presenting his ideas is not felicitous. Mr. Tickell seems to be one of those persons who have a talent and a passion for methodical classification, and an exaggerated estimate of its importance. We have no doubt that he has found the preparation of this little book a valuable help to the attaining of clear ideas on the structure of English sentences, but we should greatly pity any schoolboy who was condemned to learn his grammar from such a manual. On the other hand, we think it is possible that teachers may find in the book a good deal of useful suggestion.

The Chemistry of Plant and Animal Life. By Prof. H. Snyder, Professor of Agricultural Chemistry, University of Minnesota. Pp. xvii+406. (New York: The Macmillan Company; London: Macmillan and Co., Ltd., 1903.) Price 6s. net.

THIS is a text-book of a type which is not very satisfactory from an educational point of view, as being written to supply the needs of a special class of students. It aims at supplying the chemistry, both pure and applied, which will be required by a class of mature students taking a college course in agricultural science. No preliminary knowledge of chemistry is assumed, and the preface indicates that the work is to be completed in a session of six months with one class-room or laboratory exercise each day. In consequence, the contents range from instructions for bending glass tubes to an account of such debatable matters as the relation of gliadin and glutenin to the quality of wheat flour. It would be hardly fair to call the treatment superficial, but clearly the object of the book is not so much to educate the student as to supply him with a certain amount of information about the scientific side of practical matters, and particularly to put him into a position to follow the current investigations of the experiment stations. Of course, the task is an impossible one; no ordinary student can acquire a real knowledge of pure and agricultural chemistry in six months, but given the special conditions, the book represents Prof. Snyder's abundant experience of trying to make the most use of the limited opportunity. The first 150 pages are devoted to ordinary inorganic chemistry, then about 100 pages deal with the proximate constituents of plants, followed by a section on the general course of development in the plant. Then come discussions of the composition of individual crops, and about eighty pages on digestion and the nutrition of animals. In the earlier part of the book a number of experiments are suggested, with a useful series of questions designed to make the student think out the object of each experiment.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

A New Mineral from Ceylon.

IN the beginning of February I bought from Mr. Holland 5 cwt. of the mineral described by Prof. Dunstan in last week's NATURE (p. 510). It crystallises in cubes, and the density is substantially that found by him. Mr. Tyrer, of the Stirling Chemical Works, Stratford, was so kind as to promise to work it up for me, and the process is still being carried on.

I had hoped to have positive and definite results to communicate before describing its constituents, but the publication by Prof. Dunstan of an analysis, and his statement that he is still engaged in its investigation, makes it necessary to write this letter.

The mineral, when heated alone, gives off 3·5 cubic centimetres of helium per gram; fused with hydrogen potassium sulphate, the amount is increased to 9·5 cubic centimetres. From this source I have already stored about 12 cubic feet of pure helium extracted in Mr. Tyrer's works.

It was at first believed that the mineral was rich in uranium, but different specimens contain only from 8 to 12 per cent. of that element, agreeing in this respect with the analyses published by Prof. Dunstan. Next, the other main constituent was believed to be zirconium, but the high density of the mineral rendered this improbable. An analyst of high standing, whose daily business it is to analyse minerals of this kind, returned 82 per cent. of zirconia as a constituent; the percentage of thorium was trifling—under 1 per cent. The mineral contains practically no thorium; this has been repeatedly confirmed in my laboratory. Nor does it contain any appreciable amount of cerium, lanthanum and didymium. The oxalate is almost completely soluble in excess of ammonium oxalate—a reaction which excludes thorium and the cerium group, but which points to zirconium. The equivalent of the elements of the oxalate group, which I at first took for zirconium, excludes the presence of any large quantity of zirconium, although that element is undoubtedly present. Fractionation shows that the oxalate precipitate (the portion soluble in ammonium oxalate) gives equivalents between 25·0 (the most insoluble portion of the double sulphate) and 44·7 (the most soluble portion); by far the major part of the element has the last mentioned equivalent. The separation of this portion is now being carried out with large quantities of material; several hundredweights are being worked up.

Assuming that the element is a tetrad, which is probable from its behaviour, it undoubtedly possesses an equivalent approaching the highest number (44·7), and for this there is a gap in the periodic table between cerium and thorium; one at least of the elements present (supposing that there is more than one present) will probably have an atomic weight of about 177, preceding tantalum (182·5) in the horizontal row of the periodic table.

I am at present engaged in mapping the spectrum of this new body or bodies.

As for the radio-activity, the mineral was bought in the hope that it would have a high content of radium. There is a trace of radium present, due, no doubt, to the spontaneous change of the uranium which the mineral contains. But the radio-activity due to this source is certainly not 5 per cent. of the total.

The period of decay of the emanation appears to point to the presence of a radio-active element closely resembling thorium X. The half value is 50 or 51 seconds, and while this is not quite the time for the decay of thorium emanation, it very nearly approaches it; at present the balance of evidence appears to point to the presence of an element closely resembling thorium, but not identical with it. The total radio-activity, moreover, is much greater than can be accounted for by the supposition that the one consists of pure thoria. Within the limits of a letter I am obliged to omit many more characteristics of this curious ore which have been ascertained, but I hope soon to be able to publish

more definite results; as it is, I regret to have been obliged to tell an imperfect story.

I should like to conclude by acknowledging the great assistance given me in this work by Mr. Tyrer and by my students, Messrs. Gimingham and Le Rossignol.

University College, April 4. William Ramsay.

The Blondlot or *n*-Rays.

In this laboratory we have obtained uniformly negative results in experiments on the Blondlot rays. Our experiments were made with the help of seven observers, including five doctors, one student, and one laboratory attendant. Calcium sulphide screens rendered fluorescent in a separate room by burning magnesium were employed. They were brought into an absolutely dark room in which the observers had been kept for some time. Two forms of screens were used:—

(1) Flat screens on which a circular area on a slip of glass is covered by calcium sulphide.

(2) The later form in which a circular area at the back of a hemispherical lens is covered by calcium sulphide. The screens were made by Mr. Leslie Miller.

The screens were either held by the hands of the observers or were clipped on stands.

The observers were told first to look steadily at the screens and report any variation in brightness, calling out "bright," "dimmer," "dim," "brighter," &c., as the appearances seemed to change. Even with the screens on the slips of glass the observers after a few moments were able to call out the changes, *although there was no attempt at muscular contraction*. With the lens form of screen the changes in brightness were very marked.

We next attempted to find whether muscular contraction behind the screen caused an increase of brightness. Of course, where the observer sees a change in brightness without muscular contraction it is easy to be misled on this point. We made the observer continue to call out the degree of brightness, and we contracted the muscles of the arm behind the screens sometimes after he had called out "bright" and sometimes after he had called out "dim." In the great majority of cases the effect we looked for did not follow. In the few cases in which it occurred we naturally attributed the results to the changes in brightness which can be observed without any muscular contraction.

We next told our observers to look, as it were, into the distance beyond the bright spot, and to report on the brightness of the screens. When the accommodation of the eyes for near vision was relaxed they reported without exception that the brightness of the screens was constant, and that muscular contraction made no difference.

When observers were then asked to touch the backs of the screens, thus warming them, they reported an increase of brightness.

It is not easy to explain the phenomena we have described. We believe that there is difficulty in accommodating for the fluorescent circle, and that there is a wavering movement of the ciliary muscles, and probably also a wavering in the size of the pupils. Yet it is asserted that we can focus a point of light in a dark room, and it is difficult to see why the fluorescent screen cannot also be kept steadily in focus when it consists of a flat glass slip with fluorescent circle. In the case of the later, and presumably more successful form of apparatus, the difficulty is easily understood. In that form the fluorescent rays proceed from the back of a hemispherical lens, that is, from a point within the posterior principal focus, and they are widely divergent and thus strain the accommodation of all but near-sighted people. The fact that in every instance we found that the light becomes steady after relaxation of the accommodation is very striking.

But the phenomena observed by us do not go any distance towards explaining the results described in M. Blondlot's papers. How is it that he and many of his compatriots see increase of brightness under conditions in which we see none? Is the explanation to be found in the paper by Heinrich, "Die Aufmerksamkeit und die Funktion der Sinnesorgane" (*Zeitschr. für Psychologie u. Physiol. d. Sinnesorg.*, vols. ix and xi.), in conjunction with our observations? Heinrich found after many careful experiments that the pupil dilates when attention is directed to an object situated in the field of indirect vision, and that it dilates still more during a short mental effort, such as a calculation. He found also that on directing attention to an object in the field of indirect vision the ciliary muscle relaxes, thus diminishing the curvature of the crystalline lens, and that during mental calculation this change is very marked, causing a curvature even less than that required for vision of a remote object. He found also that under the same conditions the axes of vision tend to become parallel or even divergent.

Can it be that the mental condition of some observers in a state of expectancy reacts on the intrinsic muscles of their eyes, and thus they see what they think they should see?

We have also experimented with the rays from a Nernst lamp, but without result. John G. McKendrick. Walter Colquhoun.

Physiological Laboratory, The University, Glasgow, March 29.

Learned Societies.

In Nature of March 10, Mr. Basset directs attention to the fact that referees frequently know less about the subject-matter of the papers than the author, and that their reports frequently contain errors from their not understanding the papers.

Had Mr. Basset held a brief for the opposite camp to that which he claims to represent, he could hardly have adduced more powerful arguments in favour of the referee system.

If a paper is of any value, the author must *ipso facto* know more about the subject-matter than anyone else. If he does not he is not the proper man to write the paper. But it is just because authors so frequently send up papers in a form in which other people cannot understand them that referees are necessary.

At present few people have time to wade through pages and pages of discursive and ill explained writings on the off chance that they may ultimately light on an interesting result. On the other hand, it is desirable that workers in one branch of science should have some insight into the general character of the investigations which are being pursued by specialists in other directions. Now I have before me a number of mathematical papers which contain no indication whatever of what the authors are driving at. They begin by putting down certain formulæ which the reader is assumed to know, and when they have twisted these formulæ about a bit they stop short abruptly without any obvious rhyme or reason. There are, of course, specialists who understand and appreciate these papers, but to the man who has specialised in applied mathematics or in a different branch of pure mathematics, the whole thing as presented appears meaningless. On the other hand, I have read with interest many well expounded papers dealing with such subjects as physiology, palæobotany, or psychology of the general character of which it is easy for anyone to form an estimate, even without previous university training. The functions of a referee should be to see that the arguments in a paper are clearly put forward, and that the main conclusions are prominently stated at the beginning or end in such a way that a general survey of the ground covered can be formed by the reader before the methods are examined in detail.

I believe that a useful purpose would be served if one of the referees of a paper were in each case selected on account of his *ignorance* of the subject-matter with which the paper dealt. Transactions would then be more readable and more widely read than they are at present.

It frequently happens, moreover, that results are buried in out-of-the-way corners of lengthy papers where they get overlooked, and that when someone has published similar results in a more accessible journal an undignified priority controversy is the result, whereas the original discoverer has only himself to blame for failing to present his subject in a readable form.

Learned societies are frequently penny wise and pound foolish in issuing their transactions *uncut*, consequently those who wish to study the contents have to waste much of their time in jagging and often tearing the pages with a

paper knife. This inevitably means *so many more papers left unread.*

While on the subject of referees, I should like to protest against the impatience of many secretaries, who seem to expect the poor referee to neglect his university duties at a minute's notice and to give up his whole time to preparing a report for return post.

If Mr. Basset were to start a "British Journal of Mathematics and Physics" without adopting the referee system or some equivalent, what would he do when X. Y. Z. sent him a paper disproving the existence of gravitation, when L. M. N. wrote proving that the ether consisted of jerk-backs of energy, or when P. Q. R. called men of science fools for not agreeing with his view that the sun's photosphere was composed of diatoms of electricity?

All the same, a journal of the kind suggested, if published of a convenient size, and with the pages cut, would fill a distinct want which certainly exists. G. H. Bryan.

Euclid's Definition of a Straight Line.

I have long thought that by the words ἐξ ἴσου, commonly translated *evenly*, Euclid means *symmetrically*. The symmetry can be tested by turning the line over; for instance, the edge of a flat ruler is straight if, when turned over, it coincides with its original position.

If a long rigid body is rotated, while two points, one in each end, retain their places, every line of particles joining the two fixed points describes a surface of revolution, which is symmetrical (in the sense intended) with respect to the two fixed points. The innermost of all such surfaces is of vanishing breadth, and is Euclid's straight line.

J. D. Everett.

11 Leopold Road, Ealing, March 29.

Spawning of the Plaice.

With reference to the letters of Prof. Herdman and Mr. W. Wallace as to the commencement of the spawning of the plaice this season, it may be stated that in the Moray Firth plaice were found spawning in the last week of December, and that spawning is not yet completed. The time mentioned is rather earlier than usual for this district, and it is not unlikely that spawning has been accelerated by the mild winter. T. Wemyss Fulton.

Aberdeen, March 29.

Fossil "Rain-drops."

The preservation of impressions of rain-drops in slabs of Triassic marl has always presented some difficulty, since mud that was soft enough to receive such impressions would seem too soft to retain them.

I have to-day, at the borders of a flood plain, in a backwater of the Dorn Valley, near the Cherwell, seen exactly similar impressions in some stiff marly clay from which the flood water has lately subsided, where the surface of the tongues of clay is covered with the foot-prints of herons, rooks and smaller birds, with sun-cracks gradually widening until the clay curls into separate flakes, and the characteristic "rain-drop" pittings dispersed over the surface upon which no rain has fallen since the water subsided. This led me to seek another cause for these peculiar marks, and I soon found their origin. The film of mud over sand was in some cases still covered with about an inch of quiet water, and the decaying vegetation in the mud had given rise to innumerable bubbles that rested unbroken upon the mud bottom, like the bubbles adhering to the sides of a tumbler of soda-water. As the water very slowly leaves these bubbles some of them break, and some become coated (by surface tension, I suppose) with a thin film of mud which strengthens the dome, so that they can become larger, as they also become flatter, and sink slightly into the tenacious mud, which then contracts slightly away, so that the diameter of the circle is enlarged. When at length they disappear, they leave circular pits behind them in the half dried mud with a slightly raised ring edge, and finally, when the mud has completely dried, these shallow rounded pittings present exactly the appearance of Triassic "rain-drops" amongst the sun-cracks and foot-marks already alluded to.

I have not seen any such explanation of these "rain-drops," but it seems to remove a difficulty.

Oxford, March 19. E. C. Spicer.

THE USE OF LIGHT AND OTHER RADIATIONS IN THE TREATMENT OF DISEASE.

One of the most interesting fields of medical research at present is the investigation of the therapeutic properties of various rays, and although much has been accomplished in a few years, there is promise of a still greater future for this development of the healing art. Any advance in medical science is of the greatest moment to the general public, and cannot be too widely known, and in this respect this branch of therapeutics has had a measure of publicity which is probably unique, but which is not altogether free from harm. The discussion of purely medical details, and the description of "cures" of apparently hopeless cases in the columns of the lay Press, have unfortunately led to misconception and to terrible disappointment to many sufferers.

The fact that certain rays of light possess special physiological properties has been long known, and valuable papers on the subject were presented to the Royal Society as far back as 1872 by Downes and Blunt. But the credit of rendering the knowledge obtained by these and other observers of practical value in the treatment of disease belongs to Finsen, of Copenhagen. His first work was to show that the chemical rays of light, the violet and ultra-violet rays of the solar spectrum, have a deleterious influence upon the eruption of small-pox, and this led him to introduce the red light treatment for this disease. The patient is confined to an apartment from which the chemical rays are excluded by means of red curtains. For the treatment to be successful the curtains must be thick enough to exclude the chemical rays as completely as they are excluded by the photographer from his plates and films. In a patient under these conditions the ordinary course of the small-pox eruption is modified, the fever of the second stage is lessened, and the scarring is infinitesimal. It is not claimed that the mortality from this terrible disease is materially diminished by the light treatment, for in a certain proportion of cases there is no hope from the first, but in a large majority suffering is diminished, convalescence is easier, and disfigurement is slight.

Finsen's next work was the development of the light treatment for lupus. Lupus vulgaris is a very chronic destructive disease of the skin and mucous membranes caused by the bacillus of tubercle, the microbe which attacks and destroys the lungs in consumption. The chemical or actinic rays are here the therapeutic agents used. These rays have a definite germicidal power, and they are also capable of setting up a peculiar form of inflammation. They are the cause of sun-burns and of pigmentation of the skin from exposure to the sun's rays. In the treatment of lupus the rays of the sun, or, more conveniently in northern climates, those of a powerful electric arc light, are concentrated by means of lenses upon the diseased area. For the lenses rock-crystal must be used, because ordinary glass obstructs the passage of a considerable proportion of the rays in the ultra-violet part of the spectrum. When the sun's rays are used a light filter is employed to cut out as far as possible the heat rays at the red and yellow end of the spectrum. The light filter is a hollow lens filled with a solution of methylene blue or an ammoniated solution of the sulphate of copper. If the electric light is used the light filter is now dispensed with, as the proportion of heat rays is much less than in the rays of the sun. Even with the light filter a certain proportion of heat rays pass, and in using either the sun or the arc light it is found necessary to cool the surface under treatment. This is effected by placing in contact with the area treated an apparatus through which a current of cold water is constantly passing,

and when the electric light is used by also passing the rays through a cylinder containing distilled water, which is kept cool by a water jacket, similar to that used in the Maxim gun. Another point of importance is that the area under treatment should be rendered bloodless, for the red colouring matter of the blood prevents the passage of the chemical rays to the deeper parts of the skin. This was shown by a simple little experiment of Finsen. If a piece of sensitised paper be placed behind the lobule of the ear and a powerful light be concentrated upon it, so that the rays have to pass through the ear, the paper will not be blackened at the end of some minutes; but if the ear be compressed by two glass slides, so as to render it bloodless, and the light be concentrated as before, the sensitised paper is blackened at the end of twenty seconds. In practice the apparatus which is used to cool the surface is used to compress the area under treatment, and it is held in position by an attendant. Various means have been tried to do away with this constant personal attention, but no mechanical means yet devised can replace it, for the parts treated must be kept in accurate focus.

The light is applied for an hour at a time, and six to twelve hours after treatment the part becomes red and inflamed, and a blister commonly forms. The inflamed, blistered area heals under simple dressings. It will be noticed that the effect of light is very different from that of heat. The application of intense heat to the skin causes an immediate inflammation, a burn, while the inflammatory reaction to light does not appear for some hours. As a result of the inflammation set up, and also of the specific germicidal action of the actinic rays, the bacilli in the tissue are killed, and after successive treatments the diseased area is replaced by a pale, soft, supple scar. The cosmetic results of this treatment are unequalled. The process is essentially a conservative one. All other methods of treatment, such as removal by the knife, scraping or cauterising, are destructive and tend to produce grave disfigurement, an important point, as the disease commonly attacks the face. The disadvantages are, however, serious. In the first place, the length of time required for the satisfactory treatment of even small areas is considerable. Secondly, the apparatus is expensive, and each patient requires constant skilled attention, and this is an important item in the cost. Lastly, it is often impossible to reach the disease when it involves the interior of cavities such as the nose and mouth. In some cases also of long standing, the area involved is so extensive that the method is too slow to keep pace with the spread of the disease. With early cases a cure can be completed in a few weeks, but in some instances a cure cannot be effected in less than a year or two. A large number of cases are now on record in which patients have been free from the disease for five years and upwards, and many unfortunates who were debarred from obtaining work by their disfigurement are now in regular employment.

Certain other affections of the skin of parasitic origin can also be treated successfully by Finsen's method, notably a form of baldness; and some superficial nævi have been removed.

The use of light baths has many advocates. As commonly applied, the whole body or an affected limb is subjected to the radiations from a number of incandescent electric lamps in a closed chamber. This produces local or general perspiration, and the effect is that of a Turkish or Russian vapour bath. By another method the patient is exposed to the light from powerful arc lamps, and these appear to influence nutrition by their powerful stimulation of the skin.

To Prof. Röntgen's brilliant discovery medical science owes an incalculable debt of gratitude, for not only are the Röntgen rays of the greatest value in the diagnosis of injuries and diseases of the bones, in the localisation of foreign bodies, such as needles, bullets, &c., in the tissues, and in the demonstration of calculi, and even of diseases of the lungs and great blood vessels, but they have been found to possess therapeutic properties of immense value. In the early days of X-ray work operators and patients occasionally suffered from a peculiar form of inflammation, a so-called burn, occurring days and sometimes weeks after exposure to their action. This power has been turned to practical account in treatment. Schiff and Freund, of Vienna, showed that certain cases of lupus could be cured, at any rate temporarily, by their means, and other superficial diseases of the skin have also been found to be benefited. The results are not so certain or so permanent as those achieved by Finsen's method, but in some cases, as already indicated, the latter are inapplicable.

Not long after Schiff and Freund's discovery the rays were applied to cases of rodent ulcer, a locally malignant disease, starting in the skin and often destroying deeper structures, and even bone. Rodent ulcer usually attacks the face, and its treatment by older methods was so frequently unsatisfactory that it had received the name of *noli me tangere*. It was demonstrated that the peculiar cells of the rodent growth are destroyed by the Röntgen rays, and that they are replaced by healthy scar tissue. Recurrences do happen after apparent cure by the rays, but such recurrences are as a rule easily removed by a further application. The rays are applied to the diseased tissue for ten to twenty minutes at a time. There is little or no discomfort to the patient, and in most cases improvement is at once manifest.

The success which attended the X-ray treatment of rodent ulcer led to the hope that in it would be found the cure for cancer. But there are essential differences between rodent ulcer and cancer. Rodent ulcer is peculiarly a local disease, while the characteristic of cancer is the spread of the disease to and the involvement first of the glands and then of internal organs. The Röntgen rays have an undoubted influence upon many cancerous growths. Superficial tumours have disappeared when exposed to their action, ulceration heals, and pain is relieved, but not by any means in all cases; in some, even when the growth appears to be localised, the glands and internal organs are already involved, and there is no hope of a cure by such a purely local measure. One thing is certain, and that is that where it is possible to remove a cancer by operation that procedure should be adopted in preference to ray treatment; but where operation is out of the question suffering may be relieved by the application of the rays, and possibly the cancerous development may be checked, but cure is not to be expected. Some surgeons are now applying the rays after operation, so that any outlying cancer cells which have not been removed may be destroyed. It is as yet too early to say how far such measures are likely to prove successful.

Another therapeutic application of the X-rays demands a few words. The rays have the power of removing hair, and for this purpose are used in certain diseases where the hairs are attacked by parasites. One such disease is ringworm. The difficulty in treating this and similar diseases lies in the difficulty in thorough epilation. The rays do not kill the parasites, but they remove the infected hairs, and in that way hasten a cure. If applied for a short period only, the roots of the hairs are not destroyed, and after a time the area treated is covered with new healthy hair. The removal of superfluous hair which is so often a disfigurement by the X-rays is not to be recommended,

for the effect is not permanent unless the application is made for so long a time and so often as to run a risk of exciting a severe inflammation, with the possibility of causing greater disfigurement than the original hirsuties. Moreover, there are other more satisfactory means which are quite safe.

Radium is the latest addition to the therapeutic armamentarium. The romance of its discovery, the mystery of its radiations and emanation, its relation to some important scientific theories, and, above all, the possibility of its being the long desired cure of cancer, have fixed upon M. and Madame Curie's discovery the attention of the world. The element in the form of a bromide, and other compounds more or less pure, is now under trial in various diseases. Rodent ulcers and some superficial cancers react to it with very similar results to those obtained by the X-rays. There is no doubt that it is an agent of great value, but further observations are necessary to estimate its position. It can certainly be applied to disease in regions which it is now impossible to reach by the X-rays, but that its field in the treatment of cancer is limited is obvious. Its effect is local, so far as present observation has shown, and the remarks made above upon the influence of the X-rays in cancer apply equally here. Radium has to be used with great care, for it is powerful for evil as well as for good. If too long applied it causes destruction of tissue, and such destruction may take months to heal.

It will be gathered that rapid strides have been made in this field, and it would appear that we are but on the threshold of further developments. The latest discovery, the mysterious *n*-rays which are said to be produced by nervous and muscular action, does not appear to possess therapeutic importance, and whether it is likely to be of value in diagnosis is at present purely problematical.

IMPERIAL METEOROLOGY.

SLOWLY, but still step by step, the science of meteorology progresses, and new visions are opened up which suggest bright prospects for future possibilities, but which also lay exposed the lost opportunities of the past. Like every other science, the modern methods of observation, for at any rate the chief meteorological elements, are nearly all that can be desired, but when it is required to revert to observations made more than thirty or forty years ago, how lamentably few are the records and how uncertain in many cases is their accuracy. Further, anyone who has had occasion to hunt up early series of observations of pressure, temperature, rainfall, &c., records will have been struck with the common occurrence of breaks extending here and there for one, two, three or more years. Nevertheless, it is little use crying over the past, but strenuous efforts should be made in the future to see that the needed observations should be secured.

The more the variations of weather are studied the more is the idea strongly impressed on the investigator that these variations from year to year are not mere matters of chance, but are produced by a cause originating outside the earth's atmosphere, and with little doubt from the sun, naturally the prime factor and father of all the important weather changes.

His daily apparent journey round the earth, caused by the latter's rotation, is the origin of all the diurnal changes familiar to meteorologists.

The earth's journey round the centre of our solar system is again the origin of all the other meteorological variations which pass through their phases in a year.

From year to year, however, these daily and yearly variations, although they preserve more or less their original variations as regards their lengths of period, change in amount sometimes to a very great degree, and cause one to speculate on the probable kind of weather for the following year.

The view that these changes from year to year are due to the direct or indirect action of the sun has a very great degree of probability in its favour, since we know that this highly heated body is in an active state as deduced by the numerous and varied solar phenomena that have been observed. Further, the periodicities deduced from long series of solar observations have added another link in the chain of evidence showing that the sun's heat must be constantly varying, a fact which it is necessary to prove before solar influence can be put forth as a possible source of the terrestrial changes.

It is the work of the now numerous magnificent meteorological institutions spread over the globe for each to gather into its own particular net the meteorological changes that are occurring in its own area, and by means of these facts to forecast what kind of weather may be expected either on the following day, week or month, or as far ahead as possible. Many of these institutions for several years found that their own areas were too limited in extent to give them the necessary data for the work in hand, and so entered into a mutual compact with neighbouring countries for the exchange of certain pieces of meteorological information.

The present stage of meteorological investigation has in the last few years indicated that even this mutual help of the neighbouring countries, each working for its own immediate ends, is not sufficient for a satisfactory solution of world meteorology.

Sir John Eliot, who recently retired from the Indian Meteorological Department, one of the, if not the, finest meteorological service that exists, gives his views on this subject, which should be read by all those interested in the welfare of meteorological science (*Broad Views*, March).

Dealing with the Indian area during the period 1892 to 1902, he points out how these eleven years were unique in the history of Indian meteorology, but this condition was unfortunately disastrous to India. Not only did that extensive country suffer more severely from droughts and famines than during any other similar period for a hundred years at least, but it was paralleled, "so far as we are aware, only by the seven years of famine in Egypt in Biblical history." More interesting still is it to find that the drought of 1895 to 1902 "was a more or less general meteorological feature of the whole area, including Abyssinia, East and South Africa, Persia, Baluchistan, Afghanistan, India, probably Tibet, and the greater part or whole of Australia." Such a statement will probably recall the attention of our readers to an article published in this Journal (vol. lxvii. p. 225), in which it was stated :—"Commencing with Indian pressures (as represented by Bombay), the area was gradually extended to Ceylon (Colombo), Java (Batavia), Mauritius, and finally to Australia (Perth, Adelaide and Sydney). The striking similarity between these curves shows that over the whole of this area, which includes both north and south latitudes, the same kind of variation is in action, and therefore the whole region is intimately connected meteorologically." Sir John Eliot's remarks thus indicate the truth of this result.

In the article from which the above quotation was taken it was shown that while one hemisphere of the earth, which included Europe, southern Asia, Africa, India, and Australia, was experiencing high atmospheric pressure on the average, the other hemisphere, which included North and South America and Siberia,

was experiencing a deficiency of pressure, and *vice versâ*.

This apparent see-saw of pressure between the two hemispheres, which has a period of about four years or a little less on the average, indicates the importance of being acquainted simultaneously with the pressure conditions on *both* sides of the earth.

There seems every reason, then, for the purpose of long-period forecasting, for meteorological institutions to extend their spheres of inquiry still further afield.

Such being the case, it is important, therefore, that in this connection the views of Sir John Eliot, included in the following quotation from *Broad Views*, should be widely known, for who is there better capable of judging what is required than one who has so ably and successfully directed the Indian Meteorological Department for so many years?

"The next development of weather study will almost certainly be in the direction of international or world meteorology, and its relation to the phenomena of sun-spots and terrestrial magnetism.

"Sir Norman Lockyer has, we believe, made a most valuable and fertile suggestion which might lead up to this development. It is that the English Meteorological Office should collect meteorological data from the whole Empire, and should have a special branch to deal with and discuss the larger problems which would arise from such an extension of its field of work.

"It may perhaps be objected that Great Britain is outside the tropics, and that its weather has no connection with that of either India or Australia. This, however, is a matter which has not been taken up by any meteorologist for investigation and definite conclusions. The facts of the past ten or twelve years are, to say the least, suggestive. Whilst the Colonies and Empire in the East were suffering from drought parts of England were experiencing year after year shortage of rain. When the drought in Australia and in East India was giving way in 1903, England had a plethora of rain, almost tropical in character, disastrous to the crops.

"World Empire entails world duties, and one of these appears at the present time to be the study of meteorology from the imperial, and not solely from the national or parochial standpoint."

LABORATORIES FOR BOTANICAL RESEARCH.

THE publicity given to the opening ceremonials of the new science laboratories at Cambridge by the King and Queen on March 1 will, it may be hoped, do something to rouse those who are responsible for the welfare of the nation to a wider sense of their duties. The time has surely passed when the remarks of a well-known prelate and of a Prime Minister to the effect that they were born in a pre-scientific era could be received, if not with overt applause, at least with sneaking sympathy.

Sluggish as we are, some progress has been made. Up to the middle of the last century, and for some time after, there was scarcely a botanical laboratory properly so-called in the whole country. Now we have the Jodrell laboratory at Kew, a very modest institution when compared to the necessities of the case or to the excellent equipment of other departments of this great national establishment. The Jodrell laboratory is not intended for instructional purposes, but chiefly for study and research, and much good work has been done there.

At Cambridge, Edinburgh, Glasgow, Dublin, at University College, London, the Royal College of Science, and in many other universities, agricultural colleges and technical institutes, there are now more or less well equipped laboratories under competent direction. But these are mainly for the instruction of students. Research laboratories are still rare, and those willing and competent to utilise them are also few in number. This condition of affairs is largely due to the indifference and lack of encouragement on the part of those who ought to know better. The *cui bono* question is ever in their minds, and much too frequently on their lips. Abstract science does not appeal to their sympathies, or to their intelligence, unless some immediate practical result at once comes into view. When that happens, the commercial instinct may perchance be aroused, and they begin to ask, will it pay? Of course, no reader of this Journal is likely to undervalue abstract science, and most of them are well aware of the enormous value of the practical results that may and do result from it. But even such persons must have been startled to find how the observations of Bower and others on the minute anatomy of the prothallus and spore-producing tissues of ferns, observations which might have been thought to be too abstruse and recondite to be of any practical value whatever, have directly led up to the extremely important researches of Farmer and his associates into the essential nature of cancer!

Satisfactory as this undoubtedly is, we have only to look across the Channel to see how puny—numerically and financially speaking—are our efforts to promote original research. Our cousins across the Atlantic, a practical people if ever there was one, are even more energetic. Does a "freeze" destroy or seriously injure the oranges of Florida, what matter? In a very short time a man of science and a man of resource is on the spot. He looks for and finds a hardy stock whereon to graft the tender scion, he puts the resources of hybridisation to the test in the endeavour to procure hardy seedlings. All this is done at once by State or Government agency. Here, if anything were tried in a parallel case, it would be with great deliberation and with little or no encouragement or support.

Those familiar with what is done to promote research in the universities and colleges of the United States, as at New York, Chicago, Philadelphia, and in California, not to mention the older foundations of Harvard and Yale, must feel almost aghast at the progress that is being made, and at our own backwardness. In the *Gardeners' Chronicle* for January 30 is an article contributed by a well-known professor familiar with what is being done here as well as there. In that article he gives details as to the astonishing activity manifested in the American universities, mainly by the aid of funds provided by private individuals. We too have reason to know and appreciate what is done by the Government Agricultural Department, and by the very numerous experimental stations scattered all over the wide territories of the United States.

As we write, there comes to us a report of the establishment, under the auspices of the Carnegie Institution, of a "Desert Botanical Laboratory, the purpose of such establishment being to study thoroughly the relation of plants to an arid climate and to substrata of unusual composition." A laboratory has accordingly been erected near Tucson, in Arizona, under the management of Dr. W. A. Cannon, of the New York Botanical Garden, who has been appointed resident investigator in charge of the laboratory. What may be described as a sort of preliminary report has been drawn up by Mr. Coville and Dr.

MacDougal, and a very interesting and copiously illustrated report it is.

As some of our readers may care to see this publication, we may add that it is issued by the Carnegie Institution of Washington, U.S.A. (publication No. 6).

Vast as is their territory, and numerous as are their experimental stations and like institutions, our cousins are not yet satisfied. They have invaded British territory, in a most genial and friendly manner it is true, but still they have annexed, with our consent, a portion of the island of Jamaica, and there they have established, at "Cinchona," a botanical laboratory and research station open to the students of all countries. The direction is in the hands of Dr. Britton, of the New York Botanical Garden, in cooperation with Mr. Fawcett, the Director of Public Gardens and Plantations in the island. The policy of the "open door" pursued by the Americans in these matters prevents us from doing anything but acquiesce in their proceedings. But why what should have been a plain duty for us should have been allowed to be undertaken by others is a mystery.

We do not question the utility of ironclads and cruisers as protectors of our commerce, but it is obvious to those who are watching the proceedings of our neighbours and of our rivals that if we do not largely extend our scientific training and induce our wealthy citizens to follow the example of their American brethren in endowing science, the necessity for protection will vanish, and that not slowly.

NOTES.

Recognising the great and immediate importance of investigation of the nature and properties of radium and radio-active bodies, the court of the Goldsmiths' Company recently signified its willingness to hand over a sum of 1000*l.* to the Royal Society to constitute a radium research fund. The council of the Royal Society at once accepted the duty of administering this grant, and ordered the cordial thanks of the society to be transmitted to the Goldsmiths' Company for its generous and timely subvention to scientific research. Proposals relating to the method of utilising the fund for the assistance of scientific investigation have at the same time been communicated to the company for its approval.

The fiftieth anniversary of Sir H. E. Roscoe's graduation at Heidelberg is to be celebrated on April 22 by a reception at the Whitworth Hall, Manchester, at which a congratulatory address will be presented from his old pupils, as well as addresses from a number of universities, colleges and learned societies. In connection with this occasion efforts have been made to communicate with as many as possible of the chemical students of the Owens College from 1856–1886. If any of these have been inadvertently overlooked they are requested to send their addresses as soon as possible to Dr. G. H. Bailey, the Owens College, Manchester.

The second annual meeting of the South African Association for the Advancement of Science was opened at Johannesburg on Monday, when Sir Charles Metcalfe delivered the inaugural address. Lord Milner occupied the chair.

We learn from the *Times* that the Canadian Government has purchased the steamer *Gauss*, which was built three years ago for the German Antarctic Expedition, and the vessel is now in Bremen Harbour. The *Gauss* is to be commanded by Captain Bernier and a picked Canadian crew, and is to be employed at once in conveying relief stores and coal to the Government steamer *Neptune*, at present wintering in Hudson Bay. Subsequently she will be engaged in survey work on the coast of Labrador. Captain Bernier hopes to be able to utilise the *Gauss* in 1905 in an attempt to reach the North Pole from Canada.

The annual meeting of the Iron and Steel Institute of Great Britain will be held on Thursday and Friday, May 5 and 6. Upon that occasion the Bessemer gold medal for 1904 will be presented to Mr. R. A. Hadfield, vice-president, and the awards of the Andrew Carnegie gold medal and research scholarships for 1904 will be announced.

On Tuesday next, April 12, Prof. L. C. Miall will deliver the first of three lectures at the Royal Institution on the transformations of animals, and on Thursday, April 14, Prof. Dewar will commence a course of three lectures on dissociation. The Friday evening discourse on April 15 will be delivered by Count Vay de Vaya on Korea and the Koreans, and on April 22 by Colonel David Bruce on sleeping sickness in Uganda.

The foundation stone of a library which will be erected in connection with the British School at Athens as a memorial to the late Mr. F. C. Penrose, F.R.S., says the Athens correspondent of the *Daily Chronicle*, was laid last week by Lady Evans, in the presence of a distinguished gathering of diplomats and savants. The Greek Archæological Society has offered to present the Penrose Library with a bust of Mr. Penrose, in recognition of his great services to architecture and archæology.

The death is announced of Prof. Arthur Greeley, professor of biology at Washington University, St. Louis.

M. Jean Debrousse has bequeathed an annual revenue of thirty thousand francs to the Institute of France "in the interests of letters, sciences and arts." At a recent special meeting the institute decided, says *La Nature*, to devote five thousand francs to the publication of lunar tables.

The *British Medical Journal* states that Sir Michael Foster, F.R.S., has given notice that on April 12, the day on which Parliament reassembles after the Easter recess, he will ask the First Lord of the Treasury whether opportunity will be given to discuss in the House of Commons, before action is taken, the portion of the report of the War Office (Reconstitution) Committee which bears on the health of the army.

Reuter reports that repeated slight shocks of earthquakes were felt at Belgrade during the morning of April 4. A message from Philippopolis states that three earthquake shocks, the severest experienced during the last fifty years, were felt there between midday and 1 p.m. on April 4. The disturbance, which was from west to east, was accompanied by a loud rumbling noise; little damage was done to buildings in the city. Earthquake shocks are also reported to have occurred at several places in Greece on April 5.

Mr. John Paterson writes to the *Times* that on a voyage from New York to Plymouth on August 29, 1903, in latitude N. 49° 43′, longitude W. 25° 35′, he threw into the Atlantic a mineral water bottle in which a note was enclosed. In a letter dated March 23 Mr. Paterson was informed that the bottle was found on the shore of the bay of Trevignon, near Concarneau, in Brittany, at high-water mark of the ordinary tides. Concarneau is in latitude 47° 50′ N. and longitude 4° W., so that the bottle travelled in an easterly direction 21° 35′ of longitude and went south 1° 53′ of latitude from the place where thrown into the sea.

The New York correspondent of the *Daily Chronicle* states that Mr. Andrew Carnegie's gift of 300,000*l*. to provide a building for the various engineering societies in the city really involves an outlay of 500,000*l*., for in addition to the amount given by Mr. Carnegie there is an investment of about 200,000*l*. for two lots which will be occupied by the proposed Union Home. The offer was made originally to the five great engineering societies of the United States:—American Society of Civil Engineers, Institute of Mining Engineers, Institute of Mechanical Engineers, Institute of Electrical Engineers, and the Engineers' Club. The first named society has, however, not accepted the offer.

In a report on the German estimates for this year, Mr. Robertson, one of the secretaries to the British Embassy in Berlin, states that, in the new estimates, a sum of 800*l*. is inserted under the head "Furtherance of scientific, especially ethnological, studies in China." In explanation it is mentioned that, as the opening of China advances, a more exact study of the individuality of east Asiatic nations is becoming a necessity. It is therefore advisable to station permanently in China a German scholar well acquainted with ethnology and the Chinese language, whose object is to develop intellectual relations with a little known form of civilisation.

An article upon the route of the Tibet Mission, by the special correspondent of the *Times*, contains an interesting record of temperatures and conditions of life at high altitudes. The mission has necessitated the continued exposure of a very large number of untried men to life at altitudes ranging between 10,000 feet and 15,700 feet, and the general results are of considerable value. The lowest temperature yet reached on the route has been $-26°$ F. at Chuggia, on the Tang-la, which was, however, only an encampment. Of actual nightly exposure to cold of men and animals Tuna probably holds the record with $-17°$ F. But Phari has repeatedly reached $-15°$ F., and Kamparab, nine miles distance from Phari, might—if continual registration had been possible there—show a lower figure than either. The normal night *minimum* during January and February is probably $-10°$ F. for 15,000 feet, warming to 7° F. for 10,000 feet. Mountain sickness has been closely observed by the medical men accompanying the mission. Indigestion has been common on account of the eating of imperfectly cooked food. At 15,000 feet water boils at a temperature about 30° F. lower than at sea-level, and the normal amount of cooking is therefore quite inadequate. At 15,000 feet it is almost impossible to boil rice properly. Dal—the common red lentil of India—affords a curious example of the difficulty of cooking at high elevations. Of the five different kinds of dal supplied to the troops—Mussoor, Urad, Arhar, Moong, and Chenna—only the first is capable of being cooked at all at heights above 10,000 feet. It is difficult to make the native understand these aberrations of gastrology, and a great deal of insufficient cooking has been the natural result.

The subdirector of the Norwegian Meteorological Institute, Mr. A. S. Steen, has contributed to the *Proceedings* of the Christiania Society of Sciences an interesting paper on the diurnal variation of terrestrial magnetism, and on the possible connection of this phenomenon with meteorology. The author points out that, so far as the accuracy of weather forecasts is concerned, we stand now nearly in the same position as we stood some twenty-five years ago; the distribution of atmospheric pressure and temperature is often quite different from what might have been expected from the telegraphic reports of the previous day, and leaves the impression that there are unknown factors in cooperation. He considers that too little attention has been paid to the electrical conditions of the atmosphere, and that such investigations as have been carried on in this sense are vitiated by the observations being generally made in the lowest strata of the atmosphere. Prof. Schuster's investigations point to the probable connection of electrical currents in the atmosphere and the diurnal variation of the terrestrial magnetic elements, and Dr. von Bezold goes so far as to imagine a connection between the latter and certain meteorological phenomena. In the paper in question Mr. Steen has searched the hourly magnetic observations of eighteen stations during the polar year (1883), and has found a continuous calm period of forty-eight hours between March 18 and 20, and this period he has submitted to special examination. The author considers that, when viewed in conjunction with the researches of Schuster and von Bezold, the results arrived at are so promising as to call for wider investigations with more ample materials than were at his disposal.

In the *Physikalische Zeitschrift*, Dr. A. Korn describes a new receiver for telautography and the telegraphic transmission of half-tone process blocks. In the transmitting apparatus the writing or the points and lines of the half-tone block are formed by a non-conducting ink on a sheet of metal foil. This is wrapped round the surface of a cylinder which is rotated with uniform angular velocity. The electric current is transmitted by means of a metal pen which moves forward 0·01 inch in each revolution. In the receiving apparatus the cylinder is rotated with an angular velocity greater by 1 per cent. than in the transmitting apparatus, and at the end of each revolution it is made to await a synchronising signal by which it is restarted. The impression at the receiving station is produced on sensitised paper by a small electric lamp or vacuum tube, which by means of a suitable relay for Tesla currents is made to glow whenever the pen at the transmitting station passes over a non-conducting portion of the picture. The paper is illustrated by specimens of handwriting transmitted by this method.

In the *Popular Science Review* for March, Mr. O. Chanute gives a survey of progress in aërial navigation in a paper read by him before the American Association in December last.

M. Jules Baillaud, in a recent number of the *Journal de Physique*, sums up the opinion of the Graz conference on the firing of cannon for the prevention of hail by the following statistics:—out of fifty experts eight considered the method efficacious, nine found the efficacy doubtful but probable, thirteen found it simply doubtful, fifteen found it doubtful and improbable, and five found it *nil*.

An experiment showing the production of high frequency currents by means of the telephone has been exhibited by M. Ducretet before the French Physical Society. The apparatus employed was the loud speaking telephone of MM. R. Gaillard and E. Ducretet. The microphone and the receiver were placed in circuit with a battery of about 10 volts, so as to give a current of about half an ampere. By suitably regulating the distance between the receiver and microphone free oscillations were set up which could be maintained indefinitely, and these were increased in intensity by connecting the microphone and receiver with a metal tube.

The second part of vol. lxxvi. of the *Zeitschrift für wissenschaftliche Zoologie* contains two articles of a highly technical nature, the one, by Mr. F. Schwangart, on the

question of the origin and structure of the epithelial lining of the alimentary tube in the Lepidoptera, and the other (which is to be continued), by Mr. E. Bresslau, on the developmental history of the turbellarian worms.

It is satisfactory to learn from the scientific investigation report of the Northumberland Sea-Fisheries Committee for 1903 that, in spite of some local diminution, the improvement in the results from trawling, to which attention had been previously directed, is maintained, if the results of the whole period are taken into consideration. It is added that while the season has not been so good for the salmon and herring fishing, "white fish" have yielded better than in the previous year. Small fish have been measured, marked and returned to the sea. A few of these have been recaptured near the same places, and one in another bay. Other experiments tend to show that the migration of crabs is not so simple as has been hitherto supposed.

The *Boletim* of the Goeldi Museum at Para contains an annotated catalogue, by Messrs. Goeldi and Haymann, of the species of local mammals represented in the collection. It is somewhat remarkable to find among these a species of stoat (*Mustela*, or *Putorius, paräensis*), but there can be little doubt that this, although now domiciled in the country, was originally introduced by human agency. Two very spirited plates illustrate the paper, one showing the extraordinary width and straightness of the opening of the mouth in one of the howling-monkeys (quite unlike what we are accustomed to see in museum specimens in this country), and the other the head of one of the indigenous species of cat. Mr. O. Thomas contributes an appendix to the catalogue, in which two subspecies are described as new.

Three out of the four articles in the current number of the *Zoologist* are devoted to bird subjects. In the fourth Mr. A. H. Cocks reverts to the subject of the gestation of the badger, and arrives at what he confesses to be the very remarkable conclusion "that the pairing may take place at any time during a range of some ten months, and yet that the young are always born within a season limited to about six weeks. In other words, it appears that the gestation may amount to anything between under five and over fifteen months, and yet that the young are all born within some six weeks of each other; and, moreover, that the females which paired earliest by no means necessarily whelp earlier during the six weeks' season than others which paired several months after them."

The necessity of carefully studying the anatomy of the smaller mammals, instead of restricting our attention to the description of new subspecies founded mainly on colour, is exemplified by certain notes on the insectivorous genus Tupaia contributed by Dr. H. C. Chapman to the *Proceedings* of the Philadelphia Academy for March. These serve to show that the presence of a cæcum is by no means, as has hitherto been supposed, a constant feature of that genus. The paper concludes with a discussion on the phylogeny of the Primates, in which a provisional table of descent is sketched. In view of the researches of other biologists it is somewhat remarkable to find Chiromys figuring as the ancestor of the rodents, and Tarsius as the parent form of the insectivores, while it is scarcely less surprising to see American monkeys placed between the lorises and the monkeys of the Old World in a direct phylogenetic line. It is, however, only just to the author to mention that in the text he states that some of these suggested relationships may have to be reconsidered.

The report of the medical officer of health of the City of London for the four weeks ending March 12 details the inspection of kitchens of restaurants, &c., commenced early in the year 1902, and now just completed. There appear to be no less than 909 kitchens in the district, employing 9888 men and women. In the course of the inspection 1996 various sanitary defects were found. It would appear that the Factory and Workshop Act 1901 is adequate to deal with this class of work-place.

In the *Empire Review* for March Dr. Cooke Adams contributes an article on cancer research in Australia. His statistics show that the death rate from cancer in Australia among the British born is nearly double that among the Australian born portion of the population, being, for the age period of thirty-five years and upwards, 12·5 for the former and 6·9 for the latter per 100 deaths. Among the aborigines cancer appears to be practically unknown, although a large number live to the age period at which the disease chiefly manifests itself.

"Protozoa and Disease" is the title of an article in the *Century Magazine* by Dr. Gary Calkins. After some introductory remarks on the classes of protozoa and their life-history, the protozoan parasites causing certain diseases in the lower animals and in man are described, viz. diseases of the mole and of brook trout, malaria, scarlatina and small-pox. In scarlatina Dr. Mallory has met with structures which he considers to be protozoan organisms, and in small-pox Dr. Councilman believes that a protozoon is the cause, and that it attacks the nuclei of the cells of the skin. In vaccinia Dr. Councilman describes an organism similar to that of small-pox, but differing from the latter in that it attacks the cell bodies and not the nuclei. The article is illustrated with several excellent figures.

The last number of the *Izvestia* of the Russian Geographical Society (xxxix., 5) contains the results of an inquiry, by G. E. Grum Grzimailo, into the origin of the populations of eastern Tibet and the Kuku-nor region, the conclusion of the paper being that the presence of a white race element in the population of eastern Tibet is very probable. Another paper of scientific interest is the report by Captain Serghievsky on the pendulum observations made in Russia during the last five years. Relative determinations only, by means of the Sterneck apparatus, were carried on, those regions which offered interesting anomalies being made the subject of detailed studies, namely, the region of the well known pendulum anomaly in Kursk, the Caucasus, Turkestan (in order to ascertain the disturbing influence of the Pamir), the region covered by the geodetic triangulation for the measurement of an arc of the meridian in connection with the Spitsbergen measurements, and the stretch between Pulkova and Dorpat.

In an essay entitled "Prehistoric Pile-structures in Pits," Mr. L. M. Mann records the results of excavations made at Stoneykirk, in Wigtownshire (*Proc.* Soc. Antiq., Scotland). The discovery of these early inhabited sites was due to Mr. A Beckett, who directed attention to a row of depressions in the land, situated on the edge of a plateau. The depressions proved to be silted-up pits. In one of them, at a depth of 7 feet, there were found decayed "logs of round timber more or less vertically placed." In the silted material chips, cores, implements of flint and of other stones, as well as charcoal and fragments of pottery were found. Twigs and branches belonging to supposed wattle-work were likewise obtained. There was evidence which tended to show that the timber had been shaped by stone axes. It appears probable that the pits were used as shelters or sleeping places and workshops. The fact that the lowest stratum met with was a bluish clay suggests that a struc-

ture of wooden piling was erected in order to provide a dry floor. The ornamentation on the pottery and other evidence point to the Neolithic age as the period during which the sites were in use.

An article on the structure of the Upper Cretaceous turtles of New Jersey is contributed by Mr. G. R. Wieland (*Amer. Journ. Sci.*, February). The genera Adocus, Osteopygis and Propleura are described and figured.

The Hurricane Fault in the Toquerville district of Utah furnishes a theme for an essay on the effects of faulting on the scenery in the region of the Grand Canyon; it is written by Messrs. E. Huntington and J. W. Goldthwait (*Bull. Museum Comp. Zool.*, Harvard Coll. Geol. Series, vi., No. 5, February).

We have received the report of progress for 1903 of the University of Texas Mineral Survey, which is under the direction of Mr. W. B. Phillips. The work is carried on with especial reference to economic geology. Attention is directed to the study of the clays of Texas, by Dr. H. Ries. Under a plan of cooperation with the Texas World's Fair Commission, Dr. Ries examined the chief clay producing districts in the State, and as a result there will be exhibited at St. Louis samples of the clays, to each of which will be attached a card giving the locality, chemical composition and physical characters, such as fusibility, plasticity, strength, colour on burning, proper temperature for burning, suitability for various purposes, &c.

An interesting essay on periodic migrations between the Asiatic and the American coasts of the Pacific Ocean is contributed by Mr. J. P. Smith (*Amer. Journ. Sci.*, March). It is shown that the living faunas of the Japanese province and of the western coast of North America are rather closely allied with a large number of species in common, and they live under approximately the same conditions. Between them there lie the southern shores of Alaska and the Aleutian Islands, interrupted by the deep channel east of Kamchatka, and in this region the warm Japan current is met by the cold current from the Bering Sea, whereby the Alaskan waters and those along the shores of California are tempered. At present the migration of shallow water species is stopped by the depth of the channel at the end of the Aleutian chain, and also by the cold water which extends south-westward from Bering Sea. A rise of 200 metres would close Bering Sea, cutting off the Arctic waters, and providing a broad land bridge between Alaska and Siberia. An uprise of this, or of greater extent, in recent geologic times would allow of the intermigration of marine Mollusca between the Japanese area and that of western America, and this is the only explanation of the present distribution of most of the species that are common to the two regions. By such changes we can understand the history of the past faunas, which do not form a genetic series, but rather one showing periodically diverse origin and characters. Thus the faunal relations between western America and eastern Asia from the Trias to the present were the same, Asiatic facies alternating with periodically recurring invasions of the Boreal type. It is concluded, therefore, that there is no presumption against the contemporaneity of similar species in widely separated regions in the past.

All the volumes of the first annual issue of the "International Catalogue of Scientific Literature" have now been published, and the volumes of the second annual issue are appearing. The first catalogue of zoological literature is in two parts—one an authors' and the other a subject catalogue—and they are concerned with the publications of 1901. Of the second issue, we have received the volumes dealing with mechanics, physics, astronomy and bacteriology. The volumes can be obtained from Messrs. Harrison and Sons, St. Martin's Lane, W.C.

The second number of *The Central*—the magazine of the old students' association of the Central Technical College—contains several articles of practical value. Profs. W. C. Unwin and A. G. Ashcroft describe the engineering course and laboratories at the college, Mr. R. S. Dahl gives an account of the design of small motors, Mr. J. M. Donaldson contributes an article on electric power in the City of Montreal, and the work of Dr. T. M. Lowry and Dr. E. F. Armstrong on the mutarotation of glucose is briefly described. A photogravure of Prof. Henrici forms the frontispiece of the number.

The additions to the Zoological Society's Gardens during the past week include a Green Monkey (*Cercopithecus callitrichus*) from West Africa, two Bare-eyed Cockatoos (*Cacatua gymnopis*) from South Australia, presented by Miss Hester Forshaw; a Hairy-footed Jerboa (*Dipus hirtipes*) from Egypt, presented by Mr. A. Lethbridge; a Shining Weaver-bird (*Hypochera nitens*), a Common Waxbill (*Estrelda cinerea*) from West Africa, an Orange Weaver-bird (*Euplectes franciscana*), three African Silver-bills (*Munia cantans*) from North-east Africa, three Banded Grass Finches (*Poëphila cincta*) from Queensland, four Amaduvade Finches (*Estrelda amandava*) from India, a Fire-tailed Finch (*Erythrura prasina*) from Java, a Red-headed Weaver-bird (*Foudia madagascariensis*) from Madagascar, presented by Mrs. M. Summers; a Potto (*Perodicticus potto*), an African Civet Cat (*Viverra civetta*), two Crowned Cranes (*Balearica pavonina*), a White-throated Monitor (*Varanus albigularis*) from Lagos, presented by Dr. McFarlane; a Loggerhead Turtle (*Thalassochelys caretta*) from tropical seas, deposited; an American Flying Squirrel (*Sciuropterus volucella*) from North America, a Boatbill (*Cancroma cochlearia*) from South America, purchased.

OUR ASTRONOMICAL COLUMN.

Observations of Eros.—In one of the papers included in the *Decennial Publications* of the University of Chicago Prof. E. E. Barnard publishes the results of the micrometrical observations of Eros made at the Yerkes Observatory with the 40-inch refractor during the opposition of 1900–1901. After describing the methods of observation and discussing the errors, he gives, in tabular form, the details of each of the 7500 individual "settings" made during the series of observations. He also gives the results of a set of observations which were made during 1898 and 1900, but have not previously been published.

At the time these measures were made the oscillations of the magnitude of Eros had not been recognised, but on looking through the records Prof. Barnard discovered that the planet had often been compared, in regard to its brightness, with the reference stars, and he therefore appends the actual notes regarding the relative magnitude which were made during the period September, 1898, to January, 1901, inclusive.

Orbit of the Minor Planet Chicago (334).—Another paper of the *Decennial Publications* (Chicago) contains a discussion of the orbit of the minor planet (334) by Prof. Kurt Laves. In the introduction the author discusses the minor planets of the Hilda type in regard to their "libration," and gives, in algebraical form, the inequality which is the criterion of the existence of libration in the orbits of these bodies. He then discusses the development of the

"perturbative function," and gives the elements, step by step, for the determination of the orbit of (334).

ABSORPTION IN THE SOLAR ATMOSPHERE.—In an article published in No. 2, vol. xix., of the *Astrophysical Journal*, Mr. Frank W. Very discusses the cause which produces the apparent selective absorption of the more refrangible radiations emitted by the photosphere which takes place in the solar atmosphere. He points out that beyond certain limits the increased depth of an "emission" layer does not increase the radiating power owing to the fact that beyond these limits the increased emission is counterbalanced by the increased absorption in the outer layers; similarly the line absorption produced by a gas does not increase indefinitely with the depth. For this reason he believes that the absorbing atmosphere is everywhere deeper than is actually essential to produce the absorption observed, and consequently it makes little or no difference whether the emission and absorption take place at the centre or the edge of the solar disc. Mr. Very contends that the apparent selective absorption is due to "selective scattering" rather than to "absorption," the more refrangible radiations being scattered and reflected by the small particles which float about in the solar atmosphere; further, he thinks that the scattering does not take place solely in a thin layer immediately above the photosphere, but is active even in the limits of the outer corona. Whereas "absorption" would require that the absorbing medium should become heated "selective scattering" does not, for the radiations are simply reflected.

This theory explains the nearly constant radiations of sun-spots when nearing the limb by supposing that spots, being cooler than the photosphere, only emit, at any time, the less refrangible radiations which are not affected by the extremely fine particles that cause the scattering.

WAVE-LENGTH OF THE GREEN CADMIUM LINE.—It has been noticed by many spectroscopists who are interested in the determination of absolute wave-lengths that the wave-length of the green cadmium line at λ 5086 as determined by M. Hamy (*Comptes rendus*, No. 130, p. 490, 1900) differs considerably from the value obtained for the same line by MM. Michelson and Benoit. This discrepancy is now accounted for by M. Ch. Fabry, who shows that under the conditions obtained by Michelson in a tube of cadmium vapour *with electrodes* the line is a close doublet, whereas in the tube used by Hamy *without electrodes* it is a triplet, and the latter observer measured the less refrangible component which does not appear under the former conditions. M. Fabry has determined the interval between the component measured by Michelson and the extra line measured by Hamy, and has found that on taking the value of this interval into account the apparent discrepancy is reduced from 15 in 1,000,000 to 3 in 10,000,000 (*Astrophysical Journal*, No. 2, vol. xix.).

A BRIGHT METEOR.—Mr. Roland Mott writes to say that on March 22 he observed a bright meteor from a position four miles west of Gloucester. "The meteor was in the north-eastern sky, and first appeared at an altitude of about 45 degrees from the horizon, falling directly towards the earth. It had the appearance of a brilliant arc lamp, and far outshone the stars of the Great Bear, although they and the moon were very bright. The time was 9.58 p.m."

SPECTRA OF MIXED GASES.—From a number of experiments made in order to ascertain the reason of the predominance of one spectrum over another in a mixture of gases, Mr. P. G. Nutting, of the National Bureau of Standards, Washington, has arrived at the definite conclusion that at such low pressures (0·1 to 10 mm.) as obtain in a Plücker tube, and under a homogeneous excitation of not more than 10 milliamperes, "the spectrum of a gas of greater atomic weight will be the brighter."

During his experiments he has found that neither the relative quantities nor the metallic or non-metallic character of the vapours present affect this result. The introduction of one molecule of mercury into three thousand molecules of hydrogen will reduce the brightness of the hydrogen spectrum at least one half, and sulphur and iodine (non-metals) are nearly as effective in causing this reduction as is mercury.

About eighty combinations of the fifteen readily vapourisable elements have been studied, and it is hoped to extend the results by using quartz tubes in which even copper and silver may be vapourised.

In concluding his communication Mr. Nutting discusses the effects of chemical combination on these results, and the explanation of the latter afforded by the modern electron theory (*Astrophysical Journal*, No. 2, vol. xix.).

RETURN OF THE NATIONAL ANTARCTIC EXPEDITION.

THE *Discovery*, with the members of the National Antarctic Expedition on board, arrived at Lyttelton, New Zealand, on April 1, accompanied by the relief ships *Morning* and *Terra Nova*. The news of the safe return of the expedition has been received with satisfaction; and there is every reason to believe that the scientific results obtained will make the expedition a noteworthy one in the records of polar exploration.

The *Discovery* left England in the summer of 1901 and reached Lyttelton on November 23 of that year. A few weeks later the vessel sailed for the Antarctic, and the first news of the work accomplished was brought back by the relief vessel *Morning* in March of last year (NATURE, vol. lxvii. p. 516). It was evident from the information then received that the expedition had already achieved great success both as regards exploration and scientific observation, but some anxiety was felt as to the chances of the *Discovery* being released from the ice during the southern summer just passed. When the winter quarters of the *Discovery* were found, the ice prevented the *Morning* from approaching the vessel to a less distance than eight miles; and the transfer of coal and provisions had to be done by means of sledges. As the *Discovery* only had provisions to last until January of this year, it was considered necessary to send out two vessels to relieve the expedition and bring back the members if the ship could not get free. The *Morning* and *Terra Nova* were therefore equipped for this purpose, and sailed from Hobart on December 5, 1903, and reached the edge of the ice on January 5 of this year. There were then seventeen miles of ice between the *Discovery* and the sea, but heavy weather and explosives assisted this to break up, and in the middle of February the vessel was in open water.

Commander Scott's report upon the results of the first year's work in the Antarctic was summarised in NATURE of July 30, 1903 (vol. lxviii. p. 307); but some additional details of interest are given in Press messages from New Zealand. A Reuter message states that the interior of Victoria Land is found to rise to a height of 9000 feet, and is evidently a vast continental plateau.

Wilkes Land was found to be non-existent, the *Discovery* sailing over the region where it has been charted. Since Ross's time, the ice is alleged to have broken back 30 miles from the barrier, which is moving northward at the rate of a quarter of a mile a year.

The main practical interest of the expedition lies in the results of the magnetic investigations. Continuous observations were taken in the neighbourhood of the magnetic Pole.

One primitive form of insect life was secured, and much information obtained as to the higher forms of animal life. The latter consisted mostly of birds, including the emperor penguin, specimens of which have not previously been found in these regions. The only species of living plants secured were mosses and lichens, but sandstone fossil remains of dicotyledonous plants from an altitude of 8000 feet were obtained on a sledging trip westward.

The following particulars of the expedition are from an interview which the correspondent of the *Daily Mail* at Christchurch, New Zealand, had with Commander Scott, published in that journal on Saturday last.

All went well after the departure of the *Morning* in 1903. The ice remained fast and firm within four miles of the *Discovery*. The weather was colder but less windy than in 1902. One hundred degrees of frost were recorded in May. The routine of scientific work and observations continued as in the previous year.

Sledging opened in September under the most severe conditions. One party made a depot to the south; another

party visited Emperor and Penguin Islands and surveyed Cape Crozier with complete success. The temperatures encountered by the parties were constantly below 50 degrees and frequently below 60 degrees. The lowest recorded was 68 degrees. A third party found a new route to the west and established a depot 2000 feet up the glacier, sixty miles from the ship.

On October 6 a party started for the strait in latitude 80 degrees south. The strait was found to contain a large glacier formed from the inland ice. Detailed information was obtained as to the exact point of junction between the barrier ice and the land, and a depot established last year was found to have moved a quarter of a mile to the north. The party returned on December 13.

A party started on November 10, with five weeks' provisions, and reached a point 160 geographical miles south-east of the ship, travelling continuously over a level plain. No trace of land and no obstacles in the ice were encountered, and evidence was obtained showing this vast plain to be afloat. A most uniform series of magnetic observations was secured.

A party set out to the west on October 12, and reached a height of 5000 feet on the glacier, 80 miles from the ship, on October 18. The ship was reached again on October 21, and on October 26 another start was made. The party gained the summit on November 11, and crossed 180 degrees, the magnetic meridian, on November 20 in about longitude $155\frac{1}{2}$ degrees east.

Commander Scott proceeded west with two men for eight and a half days, and reached a point 270 miles from the ship in latitude 78 degrees south and longitude $146\frac{1}{2}$ degrees east. He regained the glacier on December 14, and reached the ship on Christmas Eve.

The interior of Victoria Land stretches continuously at a height of 9000 feet. It is evidently a vast continental plateau. No land was visible after losing sight of the ranges which front the coast. The temperatures were low and the wind increasingly strong. The glacier valley affords magnificent scenery and gives a natural geological section of the mountains. Mr. Ferrar and two men accompanied Commander Scott to the summit, and on the return journey they explored the valley in detail and discovered sandstone with plant remains.

In the middle of December a camp was formed eight miles north of the ship, and all hands were set to work on ice-saws in the neighbourhood to cut a passage out. Commander Scott arrived at the camp on December 30, and found that 180 yards of channel had been sawn in twelve days, through ice 7 feet to 8 feet thick. The open water was then 17 miles from the ship. As the canal cut had frozen over again in places, showing that the efforts were obviously futile, the men were sent back to the ship.

The relief ships arrived simultaneously at the edge of the ice on January 5. As they had closed but little on the *Discovery* by January 15, all hands were employed in sledging and collecting the instruments. The ice began to weaken between the ships on January 20, and broke rapidly towards the end of the month. The opening came within 8 miles of the ship in the early days of February. Its advance was slow, but it was increased by systematic blasting with dynamite. The crews of the relief ships were employed in making holes in the ice for this purpose. On February 12 a general break-up of the ice began, and the relief ships reached Hut Point amid much excitement. On the night of February 14 two heavy charges were exploded, and these placed the *Discovery* in open water.

On the morning of February 16 a heavy gale began. In the night the *Terra Nova* succeeded in finding shelter to the south, but in the morning was driven north. The *Discovery* dragged her anchor and was forced ashore, remaining eight hours in a critical position. The ship eventually freed herself. On February 19, 75 tons of coal were obtained from the relief ships before a fresh gale drove the *Discovery* north. The ship was kept close in along the coast line, and in the morning parted company from the other ships at Cape Washington, with a clear sea to the north.

The *Discovery* skirted the pack to the east and north, losing sight of the *Terra Nova* during a gale on February 28. It proceeded west along parallel $69\frac{1}{2}$ degrees of latitude, and on March 2 the Balleny and Russell Islands were found to be identical. It continued west to the 156th meridian of longitude. The coast-line reported in this direction was found to be a mistake. No such land exists.

Auckland Island was reached on March 15. The *Terra Nova* and *Morning* rejoined the *Discovery* on March 19 and 20, after experiencing terrific weather and being compelled several times to heave to. The results of the expedition are eminently satisfactory.

UNIVERSITY EDUCATION IN SOUTH AFRICA.

THERE was an especial appropriateness about the visit of Prof. Hele-Shaw, F.R.S., to the Cape of Good Hope University on the occasion of the degree day, on February 27, when he gave an address on the true function of a university and the directions in which university work in South Africa should be strengthened and developed. Prof. Hele-Shaw, it will be remembered, is in South Africa to organise technical education in the new colonies, and he is for the present acting as senior professor in charge of the department of mechanical and electrical engineering at the Transvaal Technical Institute. This institute will, it is hoped by the local authorities of the Transvaal, develop into a university, but the university authorities at the Cape of Good Hope naturally desire that the future shall see no undesirable competition and no overlapping between the university work of Cape Town and that of the Transvaal when the latter becomes fully organised. There is in other quarters the fear that in the work of instituting new universities an undue prominence may be given to the subjects of study of a more technical kind, and that the branches of knowledge usually associated with the inculcation of cultured ideas may be neglected. All these questions were discussed at length by Prof. Hele-Shaw.

The University of the Cape of Good Hope was incorporated by an Act of the Legislature in 1873, and thereupon took the place of the Board of Public Examiners which had been similarly established in 1858 under the administration of the late Sir George Grey. In 1879 the late Queen Victoria granted a Royal Charter to the university declaring that the degrees conferred by the university are entitled to the same rank, precedence, and consideration as the degrees of any university in the United Kingdom. But, as was pointed out by the *Cape Times* of February 29, reporting the proceedings on degree day, as it is at present constituted the Cape University is almost exclusively an examining body. It is not, in the commonly accepted sense of the term, a teaching university, and however valuable it is for South Africa to number among its educational institutions a body which has the power to confer degrees, and thereby to set the seal of its authority upon the intellectual attainments of its graduates, this is not the highest of all advantages which a university can offer. This was the ideal at which the University of London formerly aimed, but which it has been able to replace by a great teaching university which it is hoped will be soon worthy of the capital of the Empire. The need for a teaching university at Cape Town is beginning to be felt in South Africa—for a university at which the students will be brought into direct touch with the professors and lecturers, and not, as at present, an institution in which knowledge is tested wholly by examination papers. It is the influence and the teaching of the university as a whole which largely contribute to stimulate that affection for their college that is so distinguishing a feature of the great English and Scottish universities.

Prof. Hele-Shaw directed the attention of the authorities of the Cape of Good Hope University to the aspirations of those who are founding the Transvaal Technical Institute, and pointed out that their ultimate ideal is the foundation of a university for the Transvaal. Under existing conditions in South Africa, says the *Cape Times*, it may well be doubted if two university establishments could be effectively maintained without injury to the interests of one or the other. But if the country makes that progress in wealth and population and prosperity which it is hoped to see realised, the day when there will be ample room for a Transvaal university may not be very far removed. There need be no friction between those at work at Cape Town and Johannesburg respectively.

It is true that with the establishment of a mining course in Johannesburg the engineering establishment at the South African College is faced to a certain extent by competition, but there is no reason why the earlier stages of instruction should not be taken at the South African College and the final stages at Johannesburg, where special facilities will exist. As to the future contingency of overlapping, Prof. Hele-Shaw suggests, in the probable event of an engineering faculty being established, that while the Transvaal could devote itself solely to mining engineering, the Cape University could develop the study of naval, architectural and marine engineering, for which there would be special facilities in the peninsula.

In his remarks on the future relations of the University of the Cape of Good Hope and the Transvaal Institute, Prof. Hele-Shaw said the present year will see the work of a professorship of engineering commence at both places, and continued, "There need be no fear of overlapping, since such a course, though suitable, and, indeed, necessary, for any branch of the constructive professions, can in the later stages be specialised to suit the local requirements. Thus in the north mining would naturally be a strong feature of a special course, whilst your city (Cape Town) has possibilities in the way of naval architecture and marine engineering which even the wildest dreams of the projector of the ship canal to Johannesburg would never contemplate for the latter city. Such a faculty of engineering, if true to its proper aims, would, by right, take its place, as representing a learned profession amongst the other great faculties, and would doubtless have its distinctive university degrees."

Speaking more particularly of the new institution at Johannesburg, Prof. Hele-Shaw said:—"The university idea will, I trust, even at its initial stages, be fully maintained in the Transvaal Institute, not by any mere artificial standards of entrance, but by the due appreciation of the spirit in which learning should be sought and teaching given. There will be due provision made that all entering students shall by their previous training be able to take full advantage of the lectures and classes, just as provision is made for this at the South African College. But the doors of the institute will be closed to no one, however humble, who seeks such knowledge and is able to take advantage of it. This freedom for the acquisition of learning is a very different thing from the granting of diplomas to those who are unworthy. In its diplomas and certificates the institute will try to follow the highest standards, and in this we can hope for your friendly cooperation and support. For the present our mining students will derive incalculable benefit from the seal and stamp which you will set upon their university career, a seal which will derive its value from the high standard which you have ever striven to maintain amongst your graduates. You may be sure that whatever developments there may be in the future when our own university becomes an accomplished fact, the same safeguards for a university degree will be enforced for our university as there are for yours. No university degree can have any value which does not insist upon evidence of some amount of literary knowledge and include an acquaintance with more than one language on the part of its graduates—in a word, upon evidence of liberal education."

Referring to the fears expressed in some quarters in connection with a possible over-multiplication of universities, Prof. Hele-Shaw remarked:—"There is abundant evidence that the proportion of the population who are imbued with a love for higher learning and a determination to secure a university standard is far greater here than in the cities of the older countries. There may, possibly, exist some fear of what I have called a multiplication of universities—a fear that one university may arise and grow at the expense of another. I have heard this fear expressed in the instances with which I myself am personally acquainted; but I have also seen this fear prove groundless. In the first place, it is known that the university which lowers its standard in the hope of attracting students thereby inevitably compasses its own downfall, and in the second place the remarkable effect of the institution of a new university seems to be that, whilst educational enthusiasm has been aroused in a new centre, a patriotic and zealous spirit has been rekindled in the old, and both universities have flourished where before one was only languishing."

THEORY OF AMPHOTERIC ELECTROLYTES.[1]

AMPHOTERIC electrolytes are those which are capable of acting as acids towards bases and as bases towards acids. One of the simplest types is that of the amino-acids, for example, glycine, $NH_2.CH_2.COOH$, which in virtue of the NH_2 group is an anhydrous base, whilst in virtue of the COOH group it is an ordinary organic acid. When such a substance is dissolved in water, it is ionised as acid, as base, and as the salt formed by their reciprocal neutralisation. From molecular weight determinations in aqueous solution it is found that in general the molecule is simple and not double, so that the unionised salt must be

$$\overset{|}{N}H_3.CH_2.COO\rfloor$$

The theory of the ionisation and electrical conductivity of the aqueous solutions of amphoteric substances may be deduced by a consistent application of the law of mass action and Arrhenius's theory of electrolytic dissociation. If the anhydrous electrolyte is represented by the formula X, and the hydrated form by the formula HXOH, the ions found in the solution will be

$$\underset{a}{H+} \qquad \underset{b}{OH-} \qquad \underset{c}{XOH-} \qquad \underset{d}{HX+}$$

The letters beneath the formulæ represent the active masses for equilibrium of the corresponding ions. With regard to the active masses of the various forms of unionised electrolyte, it can easily be shown that these are in fixed ratios, whatever the concentration may be. We may therefore represent the sum of the active masses of the unionised forms by the letter u, and by considering the equilibrium of the different pairs of positive and negative ions, arrive at the following expressions:—

$$a=\sqrt{\frac{K+k_a u}{1+\frac{k_b}{K}u}}$$
$$b=K/a$$
$$c=k_a ua$$
$$d=k_b ua/K,$$

in which K represents the ionic product for water, k_a the dissociation constant of the amphoteric electrolyte acting as acid, and k_b the dissociation constant of the amphoteric electrolyte acting as base. The value of K is well known, and k_a and k_b may be obtained from measurements of the degree of hydrolytic dissociation of salts of the amphoteric electrolyte. For feebly ionised electrolytes u is very nearly equal to the total active mass, and may be assumed to be so in the first approximation. It is therefore possible to calculate the concentrations of the various ions from a knowledge of the constants given above and of the total concentration. From these ionic concentrations and the corresponding ionic velocities the electrical conductivity of the solution may then be calculated.

This calculation has been made from Winkelblech's data for the amino-benzoic acids, and satisfactory agreement obtained with the observed numbers. For such substances the dissociation constants calculated from the conductivity by Ostwald's formula have been always found to be abnormal. The theory given above explains the abnormality, and accounts numerically for the variation in the "constant."

In general it may be said that in the case of amphoteric acids which have a ratio k_b/K of the order 100 to 1000, the Ostwald constant k_0 is greater than the true acid constant k_a at high concentrations, falls to a minimum considerably lower than k_a, finally to rise asymptotically to the true value k_a as dilution progresses. The conductivity at the high concentrations is chiefly due to the ionisation of the electrolyte as salt, whereas at the high dilutions it is mostly due to the ionisation of the electrolyte as acid. In consequence of this, the measurement of the conductivity of solutions of amphoteric electrolytes affords no criterion of their strength as acids. An amphoteric electrolyte in which the acidic and basic constants are equal would give solutions absolutely neutral at all concentrations, and possessing a molecular conductivity invariable with the dilution, thus differing from all simple acids, bases or salts.

[1] Substance of a paper by Prof. James Walker, F.R.S. Read before the Royal Society on February 18.

SURVEY OF SCOTTISH LAKES.[1]

THE three papers mentioned below complete the account of the survey of the lochs which lie within the drainage basin of the Tay, and show that the excellent work carried on by Sir John Murray and the late Mr. F. P. Pullar is being continued in a manner worthy of the importance of the subject. It may be recalled that part i. of these publications appeared in the *Geographical Journal* for April, 1900, and dealt with the lochs of the Trossachs and Callander district; part ii. appeared in the *Journal* for March, 1901, and dealt with the remaining lochs of the Forth basin; part iii., No. 1, appeared in the same *Journal*, and dealt with Lochs Ericht and Garry in the basin of the Tay. Part i. was noticed in these columns on May 17, 1900 (see NATURE, vol. lxii. pp. 65–67).

In the introductory remarks to the first paper under notice, reference is made to the attempt to induce the Government to undertake a bathymetrical survey of the principal Scottish lakes; to the commencement of such a survey by Sir John Murray and the late Mr. F. P. Pullar, which was brought to a standstill by the sad death of Mr. Fred. Pullar; to the desire of his father, Mr. Laurence Pullar, to continue and complete the work in which his late son took such an active part; to the resolutions passed by the councils of the Royal Societies of London and Edinburgh, and by the British Association, affirming the importance and scientific value of the contemplated survey; to the interest taken in the work by the directors of the Ordnance Survey and Geological Survey, the hydrographer of the Admiralty, and the controller of H.M. Stationery Office; to the steps taken to carry out the work under the direct supervision of Sir John Murray and the staff appointed to assist him; and to the progress made up to the time of publication.

The drainage basin of the River Tay is the largest in Scotland, covering an area exceeding 2500 square miles, and it includes several large fresh-water lochs as well as many small ones, nearly all of which have now been sounded by Sir John Murray and his colleagues. The relative positions of the lochs will be seen at a glance in the index map shown in Fig. 1. In the first paper now under notice, thirteen of the lochs are dealt with, the most important being Lochs Rannoch and Earn; in the second paper fourteen lochs are dealt with, including Lochs Tay and Tummel; and in the third paper thirty-one of the smaller lochs are discussed, making a total of fifty-eight lochs fully described and elaborately mapped. Adding Lochs Ericht and Garry, previously published, the total is increased to sixty, so that only a few little lochans within the Tay basin remain unsurveyed. These sixty lochs cover an area of about forty square miles, and they drain an area twenty times greater—an area of more than eight hundred square miles. The number of soundings necessary to indicate with sufficient accuracy the relief of the bottom varies greatly, according to the dimensions, depth, and form of the basin, but usually a relatively much larger number of soundings is taken in a small loch than in a large one. Nearly seven thousand soundings were recorded in these sixty Tay lochs, or an average of 114 per loch, or 172 per square mile of water-surface. In the thirty-one little lochs included in the third paper the average number of soundings per square mile of surface is 383, while in the largest loch (Loch Tay) the average is only 91.

The sixty lochs lie at elevations varying between 140 and 2575 feet above the sea, the last mentioned, the only one above the 2000 feet level, being the little Loch nan Eun at the head of Glen Taitneach, a tributary of the well-known Glenshee, and the highest loch visited by the Lake Survey. Of the four largest lochs, Loch Ericht is the highest, 1153 feet above sea-level, then Loch Rannoch, 668 feet, then Loch Tay, 349 feet, and Loch Earn, 317 feet.

In this short notice it is impossible to refer to all the lochs dealt with, and therefore attention will be directed only to the larger and more interesting lochs. In order to show their relative dimensions and depths, the principal Tay lochs are arranged in the following tables according to (1) superficial area, (2) length, (3) volume of water, (4) maximum depth, and (5) mean depth, the particulars being given in round numbers:—

(1) *Superficial Area.*

	Square miles		Square mile
Loch Tay	$10\frac{1}{4}$	Loch Tummel	1
,, Rannoch ...	$7\frac{1}{2}$	,, Bà	1
,, Ericht	$7\frac{1}{4}$	,, of Lintrathen ...	[illegible]
,, Earn	4	,, Garry	[illegible]
,, Laidon	2	,, Freuchie	$\frac{1}{2}$

(2) *Length.*

	Miles		Miles
Loch Tay	$14\frac{1}{2}$	Loch Lintrathen ...	$1\frac{1}{3}$
,, Ericht	$14\frac{1}{2}$	,, Iubhair ...	$1\frac{1}{3}$
,, Rannoch ...	$9\frac{3}{4}$	,, Loch	$1\frac{1}{4}$
,, Earn	$6\frac{1}{2}$	,, of the Lowes ...	$1\frac{1}{5}$
,, Laidon	$5\frac{1}{2}$	,, Turret	1
,, Tummel	$2\frac{3}{4}$	,, Benachally	1
,, Garry	$2\frac{1}{2}$	,, of Forfar	1
,, Bà	$2\frac{1}{4}$	,, Daimh	1
,, Lyon	$1\frac{3}{4}$	,, Con	1
,, Freuchie	$1\frac{1}{4}$		

(3) *Volume of Water.*

	Millions of cubic feet		Millions of cubic feet
Loch Tay	56,550	Loch Drumellie .	222
,, Ericht	38,027	,, Bà	206
,, Rannoch ...	34,387	,, Lowes .	194
,, Earn	14,421	,, Daimh	190
,, Laidon ...	1,762	,, Benachally	178
,, Tummel ...	1,317	,, Clunie ...	170
,, Garry	846	,, Iubhair ..	147
,, Lyon	461	,, Ordie ..	133
,, Lintrathen ...	405	,, Kennard ..	108
,, Freuchie ...	347	,, Derculich .	108
,, Turret ...	228	,, Loch ..	103

(4) *Maximum Depth.*

	Feet		Feet
Loch Ericht	512	Loch Kennard . .	72
,, Tay	508	,, Lintrathen .	70
,, Rannoch ...	440	,, Derculich .	70
,, Earn	287	,, Ordie . .	69
,, Laidon	128	,, Clunie	69
,, Tummel ..	128	,, Iubhair	65
,, Garry	113	,, Benachally ...	64
,, Lyon	100	,, Freuchie	62
,, Daimh	95	,, Drumellie ...	58
,, Loch	81	,, Skiach	55
,, Turret	79	,, Lowes .	53
,, Fender	78	,, nan Eun ..	50

(5) *Mean Depth.*

	Feet		Feet
Loch Tay	199	Loch Clunie ..	29
,, Ericht	189	,, Drumellie ..	29
,, Rannoch ...	167	,, Ordie .. .	26
,, Earn	138	,, Benachally	25
,, Garry	50	,, Iubhair ...	25
,, Tummel . .	48	,, Derculich ...	25
,, Lyon	45	,, Lintrathen ..	23
,, Daimh .. .	39	,, Freuchie	23
,, Laidon ...	35	,, Fingask	23
,, Turret	32	,, Giorra	22
,, Fender	32	,, nan Eun	22
,, Kennard ...	32	,, Lowes	20
,, Loch	29		

The general conformation of the principal lochs may now be indicated briefly; for further details the reader is referred to the papers cited.

Loch Tay is slightly sinuous in outline and comparatively simple in conformation. A depth of 100 feet is met with about a quarter of a mile from the upper (south-western) end, and about one-third of a mile from the lower end. The basin exceeding 200 feet in depth is eleven miles in length,

[1] Bathymetrical Survey of the Freshwater Lochs of Scotland. Under the direction of Sir John Murray, K.C.B., F.R.S., D.Sc., and Laurence Pullar, F.R.S.E. Part iii. Nos. 2–6, *Geographical Journal*, vol. xxii., pp. 237–269, with seven plates of maps; Nos. 7–9, pp. 521–541, with five plates of maps; No. 10, vol. xxiii., pp. 32–61, with six plates of maps, and geological map.

distant more than a mile from the lower end, and more than two miles from the upper end. The bottom falls below the 300 feet level in two basins, the larger extending from about two miles from the lower end for a distance of 7½

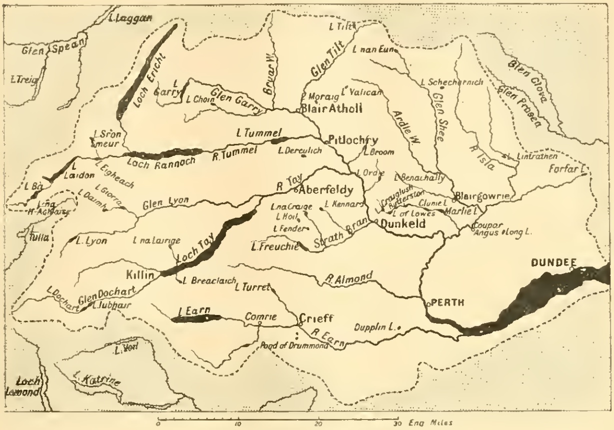


Fig. 1.—Index Map of the Tay Basin.

miles up the loch, and separated by a slight shoaling of the water over an interval of a mile from the smaller basin, which is half a mile in length. The 400-feet basin lies in the northern half of the loch, approaching to within less than four miles from the lower end, and is 3½ miles in length, while the deepest part of the loch (exceeding 500 feet) is situated about 5½ miles from the lower end, between Skiag on the south and Cragganruar on the north, the maximum depth occurring (roughly) about one-third of the length of the loch from the lower end. A view of Loch Tay, as seen from Kenmore Bridge, is shown in Fig. 2. The areas between the consecutive contour lines, and the percentages to the total area of the loch, are :—

Feet	Acres	Per cent.
0 to 100	1972	30½
100 ,, 200	1532	23½
200 ,, 300	1390	21
300 ,, 400	1017	15½
400 ,, 500	600	9
more than 500	9	less than ½
	6520	100

Loch Ericht is widest near the lower (south-western) end, narrowing towards the upper end. A constriction in the outline of the loch near Loch Ericht Lodge, about 4½ miles from the upper end, cuts it into two deep basins, but, though the width here is less than a quarter of a mile, the depth exceeds 100 feet, so that the 100-feet basin is a continuous area 13¼ miles in length, extending from less than half a mile from the lower to less than a mile from the upper end. The 200-feet and 300-feet basins are each divided into two parts by the constriction referred to, the larger part in each case being found in the southern portion of the loch. The greatest depth observed in the portion of the loch to the north of the constriction is 314 feet, the deepest water in the loch occupying the wider southern portion, where, about 3½ miles from the lower end, there is a small area exceeding 500 feet in depth. The areas between the contour-lines, and the percentages, are :—

Feet	Acres	Per cent.
0 to 100	1575	34
100 ,, 200	1160	25
200 ,, 300	875	19
300 ,, 400	476	10½
400 ,, 500	474	10½
more than 500	58	more than 1
	4618	100

Loch Rannoch is widest and deepest in the eastern half, narrowing and shallowing towards the west. It consists of one large deep basin, with two subsidiary small basins exceeding 50 feet in depth near the west (upper) end, the maximum depths in which are 84 and 54 feet respectively. The 100-feet basin approaches close to the lower (east) end, extending for nearly seven miles up the loch, while the 200-feet basin is six miles, and the 300-feet basin four miles in length, distant respectively about a quarter of a mile and half a mile from the lower end. The bottom sinks in three places along the central axis of the loch below the 400-feet level, the easternmost basin being the largest and deepest, the maximum depth of the loch (440 feet) having been observed less than two miles from the lower end; the deepest soundings recorded in the other two small basins are 404 and 421 feet respectively. The areas between the contour-lines, and the percentages, are :—

Fig. 2.—Loch Tay.

Feet	Acres	Per cent.
0 to 100	1950	41
100 ,, 200	877	19
200 ,, 300	950	20
300 ,, 400	875	19
more than 400	65	more than 1
	4717	100

Loch Earn is extremely simple in conformation and flat-bottomed in character, the depth of water increasing gradually from the shores down to the deepest part, which is centrally placed, but rather nearer the upper (west) end. A depth of 100 feet is met with less than a quarter of a mile from the west end and less than half a mile from the east end. The 200-feet basin is $4\frac{1}{2}$ miles in length, distant about three-quarters of a mile from the west end and $1\frac{1}{4}$ miles from the east end, while the 250-feet basin is nearly two miles in length, being distant $1\frac{1}{2}$ miles from the west end and 3 miles from the east end. The maximum depth of 287 feet was observed near the centre of the loch, between the mouth of the stream called Allt Bhacaidh on the northern shore and that of the Allt Dhùnain on the southern shore, about $2\frac{3}{4}$ and $3\frac{3}{4}$ miles from the west end and east end respectively. The areas between the consecutive contour-lines, and the percentages of the total area, are :—

Feet	Acres	Per cent.
0 to 100	926	$38\frac{1}{2}$
100 ,, 200	755	$31\frac{1}{2}$
more than 200	700	30
	2381	100

Loch Laidon, the largest of the Rannoch Moor lochs, lies on the boundary line between Perthshire and Argyllshire. It trends in a north-east and south-west direction, sending out a long shallow arm towards the west, and with a small shallow distinct basin, called Dubh Lochan, at its north-eastern end. The floor of the loch is rather irregular. The deepest part is in the centre of the loch, where there is a basin three-quarters of a mile in length and more than 100 feet in depth, the maximum depth of 128 feet having been observed about $2\frac{3}{4}$ miles from the south-west end and $2\frac{1}{2}$ miles from the north-east end. Outside of this main 100-feet basin, isolated soundings of 104 and 100 feet were obtained to the south-west, and a sounding of 100 feet to the north-east. The principal 50-feet basin extends from less than a mile from the south-west end to less than $1\frac{1}{2}$ miles from the north-east end, and is nearly 3 miles in length; a smaller basin, one-third of a mile in length, lies in the north-eastern part of the loch, separated from the larger basin by an interval of a quarter of a mile, with an isolated sounding of 50 feet midway between them. Of the entire lake-floor, 74 per cent. is covered by less than 50 feet of water.

Loch Tummel is the final one on the Tummel branch of the Tay, and it receives the outflow from all the other lochs on this branch, including Lochs Ericht, Rannoch, and Laidon; its drainage area is thus very considerable—about 306 square miles, or 312 times the area of the loch. It is irregular in outline and in the conformation of the bottom. The west (or inflow) end of the loch is shallow, and is being silted up by the large amount of alluvial matter brought down by the river; two large tongues of alluvium project into the loch on both sides of the river, and, indeed, the loch must formerly have extended much farther towards the west, but has been gradually silted up and shortened. Cones of alluvium have also been formed at the mouths of the inflowing streams, both on the northern and southern shores. The loch is divided into three deep basins by two ridges crossing the loch, the depth on the western ridge being 53 feet and on the eastern 56 feet, so that the 50-feet area is continuous, and nearly $2\frac{1}{2}$ miles in length, approaching to within 100 yards from the east end and a quarter of a mile from the west end. Of the three deep basins, the western one is the deepest, with a maximum depth of 128 feet; the central one has a maximum depth of 119 feet, and the eastern one a maximum depth of 99 feet. A view of Loch Tummel is shown in Fig. 3. The areas between the contour-lines, and the percentages, are :—

Feet	Acres	Per cent.
0 to 50	352	56
50 ,, 100	217	$34\frac{1}{2}$
more than 100	60	$9\frac{1}{2}$
	629	100

Loch Garry lies to the east of Loch Ericht, and resembles it in trend and in outline. The 25-feet, 50-feet, and 75-feet areas are continuous, the 50-feet area being nearly two miles in length. There are two 100-feet basins, separated by depths of 82 to 93 feet, the larger one in the southern half of the loch, with a maximum depth of 105 feet, the smaller one in the northern half, enclosing the maximum depth of the loch (113 feet). The areas between the contour-lines, and the percentages, are :—

Feet	Acres	Per cent.
0 to 50	200	52
50 ,, 100	170	43
more than 100	19	5
	389	100

Loch Lyon is extremely simple in outline and in conformation. It is nearly uniform in width, except for a cone of alluvium laid down by the river on the south-eastern shore. The lower (north-eastern) end is shallow, as though it had

FIG. 3.—Loch Tummel.

been silted up, the 25-feet contour being distant about a quarter of a mile, while at the upper end the 75-feet contour approaches to within 300 yards of the shore. The alluvial cone mentioned causes a constriction in the outline of the loch accompanied by a slight shoaling of the water, the depth here being 77 feet, deepening to 84 feet to the south-west, and to 100 feet to the north-east; the last-mentioned sounding—the maximum depth observed—occurs approximately in the middle of the loch. The areas between the contour-lines, and the percentages to the total area of the loch (which show the flat-bottomed character of the deep basin), are :—

Feet	Acres	Per cent.
0 to 25	92	39
25 ,, 50	36	15
50 ,, 75	55	23
more than 75	53	23
	236	100

The Loch of Lintrathen is the source of the Dundee water-supply, and has been raised 22 feet in connection therewith; Loch Turret similarly supplies the town of Crieff,

and Loch Benachally the town of Blairgowrie. The results obtained by the Lake Survey must be of particular interest to these municipalities, as indicating the capacities and the depths of the lochs from which they draw their water-supplies. Lochs Daimh, Kennard, Turret, and Fender, though small lochs, are interesting on account of their relatively great depth. The little Loch Fender, which has an area of only some 22 acres, is especially striking in this respect.

Temperature observations were made at the time of sounding most of the lochs, and the results are given under each loch. In the case of Loch Rannoch, the observations extended over a period of four months, and gave some interesting results as to the march of temperature throughout the waters of the loch from March to July, 1902, but usually the observations are too few to afford material for discussion, though they are available for comparison with any future observations.

The bathymetrical maps illustrating the papers are a distinctive feature, and are excellent examples of chromo-lithographic work. They are reduced from the Ordnance Survey charts to the uniform scale of 3 inches to the mile. The water-surfaces are tinted in deepening shades of blue, the darkest shades indicating the greatest depths. The land-surfaces are tinted in deepening shades of brown, the darkest shades indicating the highest elevations. Longitudinal and cross sections of the principal lochs are given, the true vertical relief drawn to scale being shown in solid black, while coloured extensions in outline represent the vertical scale exaggerated five times in order to show the relative depth with greater effect. Besides the maps there are numerous woodcuts in the text, some of which are reproduced in this notice.

Appended to the concluding paper are some valuable notes on the geology of the Tay basin, by Drs. Peach and Horne, illustrated by an admirable geological map, and on the biology of the lochs of the Tay basin, by Mr. James Murray, assistant zoologist on the staff of the Lake Survey.

In their concise sketch of the geology and glaciation of the district, Drs. Peach and Horne show that the Tay basin is geologically divided into two parts by the great fault along the Highland border—to the north-west metamorphic rocks pierced by igneous intrusions, to the south-east rocks of Old Red Sandstone age with a small patch of Carboniferous strata. Most of the lochs lie to the north-west of the Highland fault, and the groups of strata are enumerated in the order in which they are met with on proceeding northwards from the fault, their distribution being indicated, and the system of north-east and south-west dislocations which traverse the metamorphic area discussed. After dealing with the lower and upper divisions of the Old Red Sandstone, which occur to the south-east of the border fault, the authors proceed to consider the evidence relating to the glaciation of the Tay basin, which leads to the conclusion that, during the climax of the Ice age, the region must have been covered with one continuous sheet of ice; striæ have been found up to elevations of 3000 feet, showing that the highest mountains were over-ridden by the ice, the movement of which must to some extent have been independent of the existing valley-system. This stage was followed by a period of confluent glaciers, when the ice streamed over passes connecting adjoining valleys, leaving in its track lines of moraines. Finally, there was the phase of corrie-glaciers, when the glacial detritus was borne for no great distance from the local centres of dispersion.

The majority of the lochs within the Tay basin, most of them small and comparatively shallow, lie in the midst of drift deposits; several other lochs, some of considerable size, lie along lines of displacement, for example, Lochs Ericht, Garry, Laidon, and Lyon, the long axes of which coincide with the courses of more or less powerful dislocations. As typical examples of rock-basins eroded by ice-action, Lochs Rannoch, Tummel, Earn, Lubhair and Dochart are cited. The two last-mentioned originally formed one sheet of water, and have been separated by alluvial material brought down by the river; Loch Dochart is being rapidly silted up, and must formerly have extended three miles up the valley. Further up Glen Dochart a strip of alluvium five miles in length may probably represent a silted-up rock-basin. Loch Tay presents certain features differentiating it from the rock-basins cited, there being no rocky barrier close to the lake, and the Loch Tay fault runs along the course of the lake for a distance of $5\frac{1}{2}$ miles, the deepest part of the basin coinciding with this fault, to which the deflection of the original valley of the Tay must be due. Thus Loch Tay cannot be regarded as a typical example of a rock-basin, but the other rock-basins referred to seem to furnish strong evidence in support of the theory of ice-erosion.

Tow-net collections were taken in most of the lochs in the Tay basin, and have furnished Mr. Murray with material for some interesting notes on the plankton of the open water of the different lochs. The number of species is not very great, and does not vary much; each loch has a distinct character, which, notwithstanding a considerable amount of seasonal variation, is pretty constant. The genera and species usually met with in the open water of the lakes are enumerated, and although all the forms may be present in most of the lakes, the varying proportions in which they occur give rise to great differences in the character of the plankton. This lacustrine type of plankton was found even in the smallest lochs surveyed. Some of the forms are subject to considerable variation, and sometimes a single organism, usually vegetable, will so increase in a loch as to form a "Wasserblut." A brief account of the plankton-organisms observed in some fifty of the lochs visited is given.

THE HOPE REPORTS.[1]

THE fourth volume of the "Hope Reports" contains twenty papers bearing upon the study of insects in particular and the theory of natural selection in general. The most important of these is Mr. Shelford's paper on mimetic insects and spiders from Borneo and Singapore.

So long as we had only a few isolated cases of mimetic resemblance between animals belonging to different families or orders, it was possible for the opponents of the theory of natural selection to make light of them or to urge with some force the argument of the influence of similar external conditions, but as the number increases the difficulty of accounting for these wonderful mimetic resemblances by any other theory than that of natural selection becomes insurmountable. Mr. Shelford's list of mimics and their models is a long one, and as his description is accompanied by valuable field notes and is illustrated by five excellent coloured plates, it forms one of the most important contributions to the literature of the subject which has yet been published. The figures were drawn from the dried specimens as they arrived in this country, and in some cases the mimicry does not seem to be a very close one as it may be judged by the illustrations only, but it is in these cases that the value of the field notes lies.

In the description of a fly belonging to the genus Sepedon that mimics a hymenopteran (*Collyris emarginata*, Macl.), Mr. Shelford says:—

"Both of the species now under discussion were caught together on the wing on Mt. Serambu, Sarawak, and when seen alive and actively moving about were not readily distinguishable. As cabinet specimens they furnish an instance of the importance of field-work in the study of mimicry, and of the unreliability of dead impaled insects or mere figures unless, indeed, both are prepared with reference to careful observations of the living forms. The fly when alive was of a very brilliant blue like that of the Collyris, but the colour has now faded to a dusky indigo, while the abdomen being much shrunk detracts considerably from the previous resemblance. The legs are brilliant red, and constituted one of the most conspicuous features of both fly and beetle."

The tables that Mr. Shelford gives of the arrangement of these insects which mimic and are mimicked into convergent groups should be carefully studied by naturalists who may have the opportunity to study insects in the tropics.

An important series of experiments on the colour relation between lepidopterous larvæ and their surroundings is described by Prof. Poulton. In *Gastropacha quercifolia* the susceptibility to the colour surroundings appears to be restricted to the younger stages of the larva, but in further experiments Prof. Poulton found that in *Amphidasis betularia* every stage except the first and the fifth or sixth is

[1] "The Hope Reports." Vol. iv., 1900-1903. (Printed for Private Circulation.)

sensitive. These striking differences in the sensitiveness of two caterpillars to the colour of their environment are highly suggestive, and we may hope that these interesting results will be followed by further investigation on the same lines. The paper is illustrated by some beautiful coloured plates of the effects of lichen and variously coloured bark upon the colour patterns of the caterpillars.

Of the other papers in the volume, attention may be directed to Mr. Guy Marshall's interesting essay on conscious protective resemblance, and to Dr. Dixey's account of the Lepidoptera of the White Nile with some excellent cases of seasonal dimorphism in which the cryptic colour is pronounced in the dry season form.

Mr. Annandale gives a remarkable account of the mantis of the Malay Peninsula that resembles the blossom of a Melastoma, and Prof. Poulton records the capture of a swarm of *Hypolimnas misippus* on a ship 500 miles from the nearest land.

It is quite impossible to do justice in a short notice to the many interesting features of this volume, but enough has been said to show that the activity of the workers in connection with the Hope Department of the Oxford Museum continues, and that the results obtained are of striking value, not only to the specialist in entomology, but to the great body of naturalists in general who have at heart the important problems of the theory of evolution.

S. J. H.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

Cambridge.—An exhibition of 50*l*. a year, tenable for two years, is offered by the governing body of Emmanuel College to an advanced student, commencing residence at the college in October, 1904. Applications should be sent to the Master of Emmanuel not later than October 1.

Mr. Carnegie has given 10,000*l*. to Kenyon College to endow a professorship of economics.

Prof. T. G. Bonney, F.R.S., will deliver during May, at University College, two lectures in advanced geology on the subject, lessons from geological mistakes:—(1) about rocks; (2) about ice action.

Cardiff University College has received an additional donation of 5500*l*. from the Drapers' Company towards its building fund. The company has already contributed 10,000*l*. for this purpose.

Dr. F. H. Newman has been appointed educational adviser to the Durham County Council, and Mr. Hugh Ramage, of St. John's College, Cambridge, has succeeded him in the office of director of higher education for the City of Norwich.

An interesting feature of the appeal issued on behalf of the fund for providing new and adequate buildings for the University College of North Wales is the liberal response which has been made by old students of the college, the amount already subscribed or promised from this source being no less than 1313*l*.

The second volume of the report, for the year 1902, of the U.S. Commissioner of Education has reached us from Washington. This part of the report is devoted largely to statistics, from which it is easy to arrive at the exact state of each grade of education in the United States. We notice under the information given respecting universities, colleges and technological schools that the total amount of benefactions reported during 1902 by the several institutions for higher education amounted to 3,408,000*l*., of which upwards of 2,500,000*l*. was received by thirty-one universities and colleges of university standing benefiting to the extent of 20,000*l*. or more.

At a special meeting of the general council of the University of Glasgow held yesterday Lord Kelvin was unanimously elected to the Chancellorship. Tuesday, April 19, will be observed as commemoration day at the university. In the morning an oration will be delivered by Sir William Ramsay, K.C.B., on "Professor Joseph Black, M.D., of the University of Glasgow (1756 to 1766)," the enunciator of the doctrine of latent heat; and honorary degrees will be conferred. In the afternoon the medallion of the late Prof. John Young, M.D., will be unveiled in the Hunterian Museum. At a university banquet to be held in the evening Sir William Ramsay will be entertained as the guest of the evening.

A correspondent of the *Times* states that the Secretary of State for India has sanctioned the decision of the Government of India to establish an agricultural research station, with an experimental farm and an agricultural college, at Pusa, in the Darbhangah district of Bengal, and to devote to the purpose the donation of 30,000*l*. entrusted to the Viceroy by Mr. Henry Phipps for some object of public utility, preferably for scientific research. The farm is to serve as a model for similar institutions under provincial Governments, some of the existing institutions being in need of improvement. Lines of experiment are to be initiated and tested before being recommended for trial under local conditions on the provincial farms; seed of improved varieties will be grown for distribution in the different provinces; results reported from other farms will be tested; scientific research work will be carried on; and practical training will be given to students at the college, which is to be known as the Imperial Agricultural College. The students' course will be one of five years, and it will be open to young men from all parts of India. Mr. Bernard Coventry, manager of the Dalsingh Serai estate, has been appointed principal, and enters upon his new duties forthwith, but the college will not be ready to receive students until August or September of next year.

The third annual general report of the Department of Agriculture and Technical Instruction for Ireland serves admirably to show the great improvement in scientific education in Ireland since the transfer of the administration of the Science and Art Vote from South Kensington to Dublin in 1901. Many instances of this improvement could be given from this report for 1902–3, but one will suffice to show the extent of the activity of the new Irish department. With the aid of direct grants from the department out of the Science and Art Vote, and of indirect grants out of the department's endowment through technical instruction committees, 184 secondary school laboratories, involving an expenditure of, approximately, 35,000*l*., have been fitted and equipped within two years. When it is remembered that in April, 1901, there were but six science laboratories in secondary schools in Ireland, and that there are now 190 laboratories, with provision for 3500 students working simultaneously, the rapidity with which the department's programme has been adopted will be understood. Laboratories are now recognised in Ireland as an essential part of secondary school provision just as much as desks, blackboards and maps.

An important Minute on Indian education has been issued and a summary of it was published in the *Times* of Monday. The Minute deals with education of all grades, and with the educational needs of girls and women as well as of boys and men. Referring to university work, the State document points out that it has been realised in India that universities which are merely examining boards tend to accentuate the defects of the Indian intellect—the disproportionate development of the memory, the incapacity to observe and appreciate facts, and the taste for metaphysical distinctions. It is proposed, as a result of the recent commission, to reconstitute the unwieldy senates of the universities, to define and regulate the position and powers of the syndicates, and to extend by law to graduates the privilege of electing members of the senate. The universities will be empowered to provide teaching, while collegiate teaching will be tested not merely by examination, but by systematic inspection, and a higher educational standard will be enforced from affiliated colleges. Such colleges must have a properly constituted managing body, an adequate teaching staff, suitable buildings and equipment, students' residences, sufficient funds, and a proper scale of fees. Government is prepared to afford liberal financial aid to enable the universities and affiliated colleges to adapt themselves to these new conditions, trusting also that such aid may stimulate private beneficence. As regards Indian technical education, the Minute states it has hitherto been

mainly directed to the higher instruction needed to train men for engineering and other employments in Government service or in mines, mills, &c. Valuable work has been done in colleges of engineering and science, and their development is of great importance. But, with a view to the development of Indian industries by native capital for the supply of Indian markets, special technical training must be afforded, resting on the basis of a simple and practical general education acquired in the ordinary schools. In order to provide qualified men for improving Indian industries Government intends to offer scholarships to enable selected students to obtain technical instruction in Europe and America, and it invites the advice and aid of the commercial community in selecting the industries to be studied, in choosing the students, and in turning the knowledge acquired to practical account.

SOCIETIES AND ACADEMIES.

LONDON.

Zoological Society, March 15.—Dr. Henry Woodward, F.R.S., vice-president, in the chair.—Mr. R. **Lydekker** read a paper on the skull and markings of the quagga, in which he directed attention to vestiges of the face-gland of Hipparion in the skull, and expressed his belief that certain alleged differences in the colour and markings of various specimens of the quagga were due to feeding or to the manner in which such markings came out in photographs. Mr. Lydekker also read a paper on the wild ass of Mongolia, of which an example was in possession of the president at Woburn Abbey, and expressed his opinion that it was the true *Equus hemionus* of Pallas, and distinct from the ass of Tibet and Ladak. The latter he proposed should bear the name *Equus hemionus kiang*.—Mr. R. I. **Pocock** described a new species of spot-nosed monkey, of the genus Cercopithecus, from Benin, West Africa.—Mr. F. E. **Beddard,** F.R.S., read the first of a series of papers entitled "Contributions to the Anatomy of the Lacertilia." It dealt with the venous system of *Iguana tuberculata, Tiliqua scincoides*, and *Varanus griseus*.—Mr. Percy I. **Lathy** contributed a paper dealing with a collection of butterflies from Dominica, West Indies, of which three were described as new and thirteen had hitherto not been recorded from the island.

Faraday Society, March 21.—Dr. O. J. Steinhart in the chair.—On the electrolytic analysis of gold: F. M. **Perkin** and W. C. **Prebble.** The object of the researches described was to arrive at an electrolytic method of estimating gold which should be perfectly accurate and yet far more rapid than the ordinary double cyanide method. Solutions of sodium thiosulphate, of cyanide, of sodium sulphide, of potassium thiocyanate and of ammonium thiocyanate were all tried and the results compared. The first named was useless; of the others—which are all accurate the thiocyanates gave the best results, and the ammonium salt was better than the potassium. With currents of 0·2 amp. per sq. dcm. the deposition of 0·05–0·08 gm. of gold was complete in 5 or 6 hours. With a current of 0·4–0·5 amp. $1\frac{1}{2}$ to 2 hours sufficed.—Thin-film electrolysis, and a proposed application to printing: C. R. **Darling.** While investigating a process for letterpress printing by electrolysis without the use of ink—an extension of Bain's well known telegraphic printing—the author found that the final results of electrolysis, when the electrolyte forms only a thin film, often differ materially from those observed in an ordinary cell. In these experiments a carbon or metal plate (it was immaterial which) formed the anode; on this was placed an impression pad, consisting of some sheets of moist blotting-paper, upon this was the trial sheet, carrying the electrolyte film, and on this the kathode type or coin. The first experiments were made with saline solutions; silver nitrate gave a clear, permanent black image of the type, but the paper, of course, darkens on exposure; copper sulphate and nitrate yielded images that faded after a time; the same unexpected result occurred with lead, mercury salts and bismuth. The best images were obtained with manganese salts.

Physical Society, March 25.—Dr. R. T. Glazebrook, F.R.S., president, in the chair.—Note on the measurement of small inductances and capacities and on a standard of small inductance: Prof. **Fleming.** The author referred to a paper read before the society last year by Mr. W. C. Clinton and himself, in which a motor-driven commutator was employed to measure small inductances. It had since been found that very good results could be obtained in the measurement of small inductances by Prof. Anderson's method by using a telephone in place of a galvanometer and a buzzer in the battery circuit. The author had found that for long solenoids, at least 50 diameters long, the inductance could be calculated with an accuracy of about 1 per cent. by the rule:—Inductance in cm. = (length of wire in one unit length of solenoid) × (total length of wire in the whole solenoid in cm.).—A hot-wire ammeter for measuring very small alternating currents: Prof. **Fleming.** The author said that in alternating current work, particularly in taking the power factor of small transformers and of short lengths of cables, the need had been felt for an ammeter not involving the use of iron capable of measuring currents as small as 0·01 or less of an ampere. He exhibited an ammeter capable of being made to read currents as small as 0·002 with fair accuracy. The arrangement was as follows:—Two very fine platinoid or constantin wires, about 1 metre long and 0·05 or even 0·02 mm. diameter, are supported on a wooden rod with arrangements for adjusting their tensions. These wires are 5 mm. apart, and are held down at the centre by delicate spiral springs. The two wires are embraced at the middle by a small loop of paper carrying a very small plane mirror. These wires are enclosed in a box, the lid of which carries a lens. By this means the light of a straight carbon filament of a glow-lamp, or of a slit illuminated by an arc lamp reflected by this small mirror can be focused on a screen of ground glass. If a current is passed through one of these wires it sags down slightly, and the square root of the displacement of the image on the screen is almost exactly proportional to the current passing. Dr. W. **Watson** exhibited and described a form of ammeter for small alternating currents. The current to be measured flows through a piece of iron wire bent into the form of a right angle. This is linked with a similarly shaped piece of nickel wire forming part of a galvanometer circuit. The thermo-E.M.F. at the junction, produced by the heating effect of the current, sends a current through the galvanometer which can be measured in the usual way. The current to be measured is practically proportional to the deflection of the galvanometer.—Energy of secondary Röntgen radiation: C. G. **Barkla.** To measure the intensity of radiation electroscopes were placed in a primary beam of Röntgen rays and in a secondary beam proceeding from air in a direction perpendicular to that of propagation of the primary rays. By comparison of the two rates of leak when no absorbing plates were used and when similar aluminium plates were placed before each electroscope, it was found that the absorbability of the secondary rays differed from that of the primary by less than 5 per cent. of its value. It was, however, found that a secondary beam of the same intensity as the primary would produce a slightly different number of ions in a given volume of air, consequently the radiations differ slightly in character. The difference in what may be called the "ionising powers" was evidently greater when the primary beam consisted of more penetrating rays. The fraction of energy lost in secondary radiation was very nearly, if not entirely, independent of the character of the primary radiation. The law which the author had previously found to govern the intensity of radiation from gases was found to be equally applicable to those light solids which are the source of a radiation differing little in character from the primary, *i.e.* the energy of secondary radiation from these substances situated in a beam of definite intensity is proportional to the quantity of matter through which the primary beam passes.

PARIS.

Academy of Sciences, March 28.—M. Mascart in the chair.—On the physical constants of some fluorides of phosphorus: Henri **Moissan.** Phosphorus trifluoride, pentafluoride, and oxyfluoride were liquefied after careful purification, and their melting points and boiling points determined by means of an iron-constantin thermo-couple.—On the production of quartziferous rocks in the course of the eruption of Mont Pelée: A. **Lacroix.** From an extended series of observations on Mont Pelée, the conclusion is drawn

that the crystallisation of quartz in a volcanic magma does not necessarily require a great depth, and that the conditions regarding pressure, apparently indispensable for the mineralising action of steam, may be realised near the surface, as in the dome of Mont Pelée.—M. Guichard was elected a correspondant for the section of geometry in the place of M. Lipschitz.—On the possibility of showing, by a contrast phenomenon, the objective action of the n-rays on luminous calcium sulphide: J. Macé **de Lépinay.** M. Blondlot has shown that whilst the luminosity of the phosphorescent surface when the rays strike it at nearly normal incidence is increased, it is diminished when the angle of incidence is very oblique. Advantage is taken of this, two screens being arranged, the one vertical and the other nearly horizontal, the intensity and angle being adjusted so that in the absence of the n-rays the two appear exactly alike. Under the influence of the rays, the one increases and the other decreases in luminous intensity, the contrast of the two rendering the effect more striking.—On the applications of the diastoloscope to the study of the displacements of luminous objects: C. **Chabrié.**—On osmosis, a reply to M. A. Ponsot: A. **Guillemin.**—The factors of equilibrium, capillary pressure and gravity: A. **Ponsot.** Some applications of the phase rule.—On the properties of curves representing indifferent states: A. **Ariès.**—On the coagulation of colloidal solutions: Jacques **Duclaux.**—The separation of chromium and vanadium: Paul **Nicolardot.** The separation is effected by the formation of chlorochromic acid by the action of fuming sulphuric acid in the presence of a chloride.—The preparation of ether oxides by means of magnesium compounds and halogen methyl ethers, XCH_2OR: l'Abbé J. **Hamonet.** Bromo-methyl ethers are readily acted upon by alkyl-magnesium compounds, giving higher homologues of the ethers. Methyl benzyl, amyl propyl, and phenyl-ethyl methyl ethers have been prepared in this way, the yields being very good.—On nitrogen phosphorus bases of the type $(RNH)_3P.NC_6H_5$: P. **Lemoult.**—The application of acetylene gas to the heating of an incubator by means of an automatic temperature regulator: H. **Joffrin.**—New observations on the diastatic formation of amylocellulose: A. **Fernbach** and J. **Wolff.**—Cephalisation in the annelids and the question of metamerism: A. **Malaquin.**—On the morphology of the trypanoplasma of *Phoxinus Laevis*: Louis **Léger.**—The subterranean fauna of the caves of Padirac: Armand **Viré.**—The endophytic fungus of orchids: Noel **Bernard.** In a previous paper the author has shown that a fungus is necessary in the fertilisation of a particular species of orchid, and an endophytic fungus, morphologically identical, has now been isolated from other species of orchids of diverse origin.—On the earthquakes of Roumania and Bessarabia: F. de Montessus **de Ballore.**—The emission of the n-rays in phenomena of inhibition: Augustin **Charpentier** and Édouard **Meyer.**—On the origin of lactose. Experimental researches on the ablation of the mammary glands: Ch. **Porcher.**—The resistance of rats to arsenical poisoning: F. **Bordan.** Rats can support doses of arsenic three times greater than those recognised as being fatal to man. They are more susceptible to small daily doses.—The action of formic acid on the organism: L. **Garrigue.**

DIARY OF SOCIETIES.

THURSDAY, April 7.

Linnean Society, at 8.—The Morphology and Anatomy of the Stem of the Genus Lycopodium: C. E. Jones.

Röntgen Society, at 8.30.—Exhibition Evening.

FRIDAY, April 8.

Geologists' Association, at 8.—On the Metamorphism of Sediments: G. Barrow.

Malacological Society, at 8.—Description of apparently New Species of Corbicula, Melania, Vivipara and Lagochilus from Java: Rev. R. Ashington Bullen.—The Hawaiian species of Opeas: E. R. Sykes.—On some Non-marine Hawaiian Mollusca: C. F. Ancey.—Description of a New Species of Ancilla from New Zealand: Rev. W. H. Webster.—Report on a Small Collection of Helicoids from British New Guinea, with Description of a New Species: G. K. Gude.

Royal Astronomical Society, at 5.—Milky Way Charts of the Heavens on Argelander's Scale 1°=20mm.; with Description of the Lenses and Mounting by H. Dennis Taylor and Alfred Taylor: J. Franklin Adams.—Observations of the Minor Planet (324) Bamberga at Windsor, N. S. Wales: John Tebbutt.—Corrected Continuation of Brünnow's "Tafeln der Flora": A. M. W. Downing.—Note on Elliptic Motion: Asaph Hall.—The Rousdon Variable Star Observations: H. H. Turner.—Measures of the Double Stars in Struve's "Mensuræ Micrometricæ," collected and discussed: Thomas Lewis.

MONDAY, April 11.

Society of Chemical Industry, at 8.—The Volatilisation of Lead Oxide from Lead Glazes into the Atmosphere of a China Glost Saggar and its Effect upon the Leadless Glaze Ware in the same Saggar: W. Thomason.—The Preparation of Lead Glazes of Low Solubility and some Points to be Observed in the Process: W. A. Thomason.—The Action of certain Solutions upon Aluminium and Zinc: Watson Smith.

Aristotelian Society, at 8.—The Emotional Origin and the Assumed Objectivity of Moral Judgments: Dr. Edward Westermarck.

Victoria Institute, at 4.30.—The Conception of the Great Reality: T. Klein.

TUESDAY, April 12.

Royal Institution, at 5.—The Transformation of Animals: Prof. L. C. Miall, F.R.S.

Institution of Civil Engineers, at 8.—Recent Developments in Cargo and Intermediate Steamers: Edwin W. de Rusett.

WEDNESDAY, April 13.

Society of Public Analysts, at 8.—The Microscopic Examination of Metals (Illustrated by Lantern Slides): J. H. B. Jenkins and D. G. Riddick.—Cod Liver Oil and other Fish Oils: J. F. Liverseege.—Note on Mushroom Ketchup: J. F. Liverseege.

Geological Society, at 8.—On the Discovery of Human Remains beneath the Stalagmite Floor of Gough's Cavern, near Cheddar: H. N. Davies.—The History of Volcanic Action in the Phlegræan Fields: Prof. Giuseppe de Lorenzo.

THURSDAY, April 14.

Royal Institution, at 5.—Dissociation: Prof. Dewar, F.R.S.

Institution of Electrical Engineers, at 8.—Direct Reading Measuring Instruments for Switchboard Use: K. Edgcumbe and F. Punga. (Continuation of discussion.)—Eddy Currents and Eddy Current Losses in Cable Sheaths: M. B. Field.

Mathematical Society, at 5.30.—On a Plane Quintic Curve: Dr. F. Morley.—Mathematical Analysis of Wave-propagation in Isotropic Space of p Dimensions: H. T. Havelock.—On Functions Generated by Linear Difference Equations of the First Order: Rev. E. W. Barnes.—Note in Addition to a Former Paper on Conditionally Convergent Multiple Series: G. H. Hardy.—Spherical Curves. Part II: H. Hilton.—Perpetuant Syzygies of Degree Four: P. W. Wood.—Transformations of the function $F([\alpha]\,[\beta]\,[\gamma]\,x)$: Rev. F. H. Jackson.

FRIDAY, April 15.

Royal Institution, at 9.—Korea and the Koreans: Rt. Rev. Msgr. the Count Vay de Vaya and Luskod.

Institution of Mechanical Engineers, at 8.—*Discussion*: Compound Locomotives in France: M. Edouard Sauvage.

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THURSDAY, APRIL 14, 1904.

THE METALLOGRAPHY OF THE ALLOTROPIC SCHOOL.

Microscopic Analysis of Metals. By Floris Osmond, Paris. Edited by J. E. Stead, F.R.S. Pp. vii+178. (London: C. Griffin and Co., Ltd., 1904.) Price 7*s.* 6*d.* net.

THIS book is a translation of a French edition embodying several papers published by M. Osmond between 1895 and 1900. The editor, Mr. Stead, in a somewhat florid preface, states that he has confirmed most of Osmond's assays, and claims that the book must be regarded "as a standard work on metallography." This claim will be difficult to justify, since an *ex-parte* statement of the views of the leader of the allotropic school of metallurgy can hardly constitute a standard work, in which necessarily the facts and theories of both schools of thought should be impartially set forth and enunciated. Again, the work is to some extent unsystematic, as in its early pages gold, steel, silver and bronze are mixed together in a somewhat puzzling manner, and such important alloys as white metal and brass are not dealt with at all. Most of the photomicrographs are excellent, whilst a few are very indifferent.

In his preface Mr. Stead highly eulogises the method of "polish attack" for revealing structures. There is no doubt that it is useful for developing structures in an exaggerated form, but for the identification of constituents it is a method prolific in errors. With unconscious naïveté, M. Osmond on p. 73 admits this, remarking, "It is necessary to look at the sample periodically in order to stop when the desired effect is obtained." In an acute controversy between two schools of scientific thought, a method capable of giving a "desired effect" would seem a little out of place, and a method giving the actual result more desirable.

On p. 73 it is quite evident that M. Osmond has not realised that what he calls his "chemical attack" is really an electrochemical or galvanic attack, since efficient etching is achieved owing to the fact that the various constituents assume in the electrolyte or etching liquid either the electronegative or electropositive position. The latter, or anode, constituents are attacked, whilst the former, or kathode, constituents are relatively untouched. It is necessary to direct attention to a photomicrograph on p. 53, Fig. 34. This purports to be the structure of gold containing 0.2 per cent. of bismuth. The metal appears to be pure gold, as no sign of the well-known bismuth eutectic cement is visible between the crystals; Messrs. Osmond and Stead in publishing this structure must have forgotten that the late Sir W. C. Roberts-Austen admitted that he was not sure that the sample contained any bismuth.

Turning to steel, M. Osmond remarks on p. 107:—

"My trials have been specially carried out on five samples of the purest classes of steel made industrially, containing varying amounts of carbon, other foreign elements being in small and very slightly differing proportions."

Practical steel metallurgists will be little inclined to agree with the foregoing paragraph, since on referring to the table on the same page and the information on the following pages, it will appear that No. 1 sample is Swedish wrought iron (containing the unusually high percentage of 0.25 per cent. of manganese) which has been submitted to the malleable iron process of annealing in ore, and is hence a product unknown to commerce. No. 2 sample is an extra soft open-hearth steel. containing 0.14 per cent. of carbon and only 0.19 per cent. of manganese. This steel must have been very "wild" and oxygenated. No. 3 is a commercial steel rather low in manganese. No. 4 is a crucible turning-tool steel containing no less than 0.35 per cent. of silicon, being hence abnormal and unfit for water quenching experiments. No. 5 is stated to be extra hard cemented bar; as it contains 1.57 per cent. of carbon, it cannot be correctly classed as extra hard, but may appropriately be called abnormal, as it contains about six or seven times the amount of manganese usually present. Throughout his investigations M. Osmond has ignored the important influences of manganese and silicon.

Turning to the photomicrographs of the 0.14 per cent. carbon steel, there will be found on p. 116, Fig. 56, the structure of this steel magnified 100 diameters, the crystals shown being very coarse. On p. 117, Fig. 57, is shown the same steel magnified 100 diameters after re-heating to 750° C. A most remarkable fining down of the structure appears to have taken place, and this in spite of the dictum of Mr. Stead that such fining down only takes place at about 900°. Probably a simple explanation of these misleading photomicrographs is to be found in careless editing, likely hopelessly to puzzle students. The "v × 100 diameters" should, under Fig. 56, and repeated in the text, p. 114, probably read "v × 1000 diameters." In the interests of students it would be well if the publishers inserted an erratum slip in connection with this unfortunate error.

On p. 145 it is stated in the last paragraph:—

"C. Influence of Quenching.—A rondelle was heated and quenched at 735° in water at 15°. Hardening at this temperature produces fractures." [1]

That quenching at 735° produces fracture is opposed to the accumulated experience of a century and a half. The explanation of the isolated fact upon which M. Osmond bases so sweeping a generalisation is to be found in the circumstance that his tool steel was so impure with silicon as to be almost unfit for water hardening. With reference to the foot-note (the accurate translation of which has been verified from Osmond's original memoir published in May, 1895), it is no doubt true that the procedure there advocated would tend to prevent cracking, but unfortunately it would also prevent hardening, since steel quenched after the finish of the transformations during the cooling would be quite soft, because the carbon

[1] "The whole secret of hardening without cracking appears to be in quenching before the end of the transformations (during the heating) or after their finish (during the cooling). But that is easier said than done when the eye is the only guide. Hence the necessity for specialists. Again, these specialists are often found in error, when the point to which they have been accustomed is changed. Then they declare that the new steel is bad."

would be necessarily existing in the normal carbide condition.

Turning to the vexed question of nomenclature, the chapter on what M. Osmond calls the distinct constituent "sorbite" will hardly convince those who regard this substance as merely the first of three phases of pearlite. On p. 87 the author says, concerning sorbite:—

"Often very fine and deep lamellæ of cementite are found which are more or less continuous: this is what Fig. 45 (polish-attack v × 1500) ought to show, if the feebleness of the original photograph has been sufficiently reproduced, which is doubtful."

The reviewer does not pretend to grasp the meaning of this paragraph, unless owing to faulty translation the word feebleness has been substituted for delicacy. The following lines on p. 91 are also obscure; referring to sorbite M. Osmond says:—

"In the first edition of this work I did not give with sufficient clearness, ideas which were perhaps slightly confused."

With reference to "martensite," which M. Osmond calls "the fourth constituent," many metallurgists hold that it is a crystalline structure found in both hardened and unhardened steels, and hence cannot be a constituent.

It is stated by Mr. Stead in his preface that the special appendix on what M. Osmond calls the constituent "austenite" renders the work complete. On p. 39, Fig. 20, is figured in an excellent photomicrograph a pale substance stated to be austenite, and a dark substance which is called martensite. Carbonists, however, hold that the pale areas are hardenite containing dissolved cementite, the dark areas being a mixture of hardenite and free cementite (M. Osmond's methods are evidently not sufficiently delicate to detect in the dark so-called martensite the constituent last named). On etching, the hardenite with the free cementite assumes the anode position, but the areas of hardenite with the dissolved cementite assume the kathode position, and are hence unacted upon.

In the appendix on "austenite," a 1·55 per cent. carbon steel was evidently annealed in iron ore until the surface carbon was reduced to 0·35 per cent., the middle still remaining at 1·55 per cent. The composite mass was then quenched, polished and scratched with a needle. M. Osmond then found that the 0·37 per cent. region was harder than the 1·55 per cent. region, and hence that "austenite" is soft. No proof is given that in the high carbon region the separation of graphite had not been brought about by the annealing. However, no practical steel metallurgist can believe that a 0·37 per cent. carbon steel, rapidly quenched from 1050°, is harder than a 1·55 per cent. carbon steel quenched under the same conditions, because it has been frequently established that the latter will scratch quartz (7) and the former only apatite (5).

Concerning hardness, M. Osmond says on p. 83 that cementite has a hardness of 6 (felspar), and is harder than quenched steel. It is well known to mineralogists that the best classes of pen-knife blades (*which have been tempered*) have a hardness of 6 to 6·5, and that fully hardened steel has a hardness at least equal to that of quartz (7).

In connection with micrographic definitions it is interesting to note that within a year two books dealing with the microstructure of metals have been published by prominent members of the allotropic school, namely, the work under review and one by Prof. Howe. It will be well here to quote the respective definitions given as to the nature of austenite.

Osmond (p. 98).—"To obtain it" (austenite) "the temperature of the steel must be above 1000° and the temperature of the quenching bath a little below, or just at, 0° C., and the proportion of carbon must exceed 1·1 per cent."

Howe, "Iron, Steel and other Alloys" (p. 179).—"Austenite, the characteristic and chief constituent of suddenly cooled, *i.e.* 'hardened' steel, is a hard, brittle mass, with a needle-like structure, and is a solid solution of carbon in iron, the proportion of carbon varying from nothing up to about two per cent."

Of allotropic definitions, students of metallography, somewhat modifying the words of Enobarbus, may well say:—

"Truth cannot wither them, nor custom stale
Their infinite variety."

Also Prof. Howe's reference to "a solid solution of carbon in iron" containing no carbon seems distinctly Hibernian.

All students should obtain M. Osmond's book. His brilliant and valuable thermal work and the charm of his ingenuous writings have made him many friends amongst those who strenuously oppose his theories and nomenclature. His book gives a fairly clear enunciation of his views, which are now accessible to all, whereas before they had been fully set forth only to those familiar with his original memoirs in French; nevertheless, a perusal of his book will reveal to many metallographists the fact that his patient work has been carried out in an environment perfectly detached from the stern actualities of the great world of practical steel metallurgy. J. O. Arnold.

ZOOLOGICAL ESSAYS.

Mostly Mammals. Zoological Essays. By R. Lydekker. Pp. ix + 383; with sixteen full-page illustrations by the Duchess of Bedford, Lord Delamere, the Hon. Walter Rothschild, J. Wolf, and others. (London: Hutchinson and Co., 1903.) Price 12*s*. 6*d*.

THOSE who already know these zoological essays will welcome their re-publication in book form; those who have not previously discovered them in periodical literature may be envied their treat in store. For the essays are at the high-water mark of zoological exposition; they are vividly interesting, yet scrupulously accurate; they are rich in fresh facts, salted with big evolutionary ideas. The author is well known as one of the foremost experts on mammals, and he has exhibited for many years the great gift of discussing difficult problems "popularly," without blunting the edge of his scientific thoroughness.

Some of the essays discuss man's influence in ex-

termination and in domestication. We are reminded that the nineteenth century, so progressive for zoology, is responsible for many sad exterminations, in some of which man has played a careless part. The possibilities of adding to the list of domesticated animals are discussed, but the result of this interesting inquiry is not encouraging: it may be that the elephant and zebra will yield to domestication in Africa; the number of herbivores capable of acclimatisation in parks can be greatly increased, but the secret of domestication seems to have been lost as civilisation was gained, and no new additions of importance can be looked for with any confidence. It almost seems as if our ancient forbears had exhausted the possibilities. This naturally leads to a discussion of the origin of domesticated mammals, in the course of which it is confessed that we are unable to point to the ancestral stock of the sheep, and that there is great uncertainty in regard to the horse. The breeds of goats seem to be derived from the Persian pasang, the donkey seems referable to a Somaliland wild ass, and it is maintained, perhaps too dogmatically, that the numerous breeds of domesticated cattle in Europe all trace their ancestry to the great extinct wild ox, or aurochs. The difficult problem of extermination recurs in an essay on "A Land of Skeletons"—Argentina, once the headquarters of glyptodons, mylodons, megalotheres, and other splendid giants, which died off one after another through the long ages during which the mud of the Pampa was accumulating. Here man cannot have been the eliminating factor, but what the "death-bringing shackles" were we do not know.

For another group of essays the key-word is *distribution*. The marked individuality of the fauna of Celebes, the possibility of a previous land-connection between South America and Australasia, the characteristics of the African fauna, the inhabitants of deserts, are among the subjects discussed. Opportunity is found to correct the still lingering belief that deserts are uninterrupted plains of smooth sand, originally deposited at the bottom of the sea, from which they have been raised at a comparatively recent epoch.

"It may be laid down as a general rule that the greater the amount of sand to be found in a desert, and the greater the difference between the animals inhabiting that desert from those dwelling in the adjacent districts, the greater will be the antiquity of the desert itself. In the case of a desert forming a complete barrier across a continent, like the Sahara, if the animals on one side are quite different from those on the other, its antiquity will be conclusively demonstrated."

In another group of essays we have illustrations of the light which past history sheds upon the present. Thus Mr. Lydekker discusses some extinct Argentine mammals, such as the "ground-sloths," some of which "appear to have been kept in caves as domesticated animals by the ancient inhabitants of Patagonia" (!); the armour-clad whales, such as Zeuglodon, the characters of which point to an affinity between toothed whales and carnivores; the ancient hippopotamuses; and the prehistoric cats and dogs.

Coloration is the key-note of another group of essays. Protective coloration in large animals is illustrated by the Somali giraffe (well shown by one of Lord Delamere's photographs of a giraffesque thicket), by Grévy's zebra, and by many deer; but the point is emphasised that in many other cases, such as the males of the Indian blackbuck, of the white-eared kob, and of the banting, no quite satisfactory reason can be assigned for the development of the characteristic colouring. This discussion naturally leads on to the essay which deals with stripes and spots in mammals, in regard to which it is shown that, while there may be a substratum of truth in the late Prof. Eimer's "longitudinal-spotted-transverse-uniform" theory, it does not cover the facts. Thus transverse stripes appear in some of the most primitive of all mammals, and reappear in certain specialised groups where there is no evidence of a previous spotted stage having been passed through. From this theme we are led on to a discussion of "How Arctic Animals Turn White," in connection with which the importance of Metchnikoff's researches on the *rôle* of phagocytes in the blanching of hair is recognised. As to the protective value of the blanching there is no doubt. Under the striking title "An Invisible Monkey," Mr. Lydekker describes the remarkable black and white coloration of the guerezas (Colobus), which harmonises with the black-barked boughs thickly draped with pendent masses of grey lichen. "As the monkeys hang from the branches," writes Dr. Gregory, "they so closely resemble the lichen that I found it impossible to recognise them when but a short distance away." Another essay is devoted to the peculiar hair of the sloths, where resemblance to a lichen-clad knot is enhanced by a growth of green algæ on the hairs. A more difficult subject is the coloration of cowries, some lines in the manifold evolution of which the author tries to decipher. That banding was the original type seems to be indicated by the fact that it prevails in the young of the great majority of species.

Other essays discuss monkeys' noses and hand-prints, the aye-aye and the flying squirrels, the beaver, the quagga, cave-animals, giant land-tortoises, nursing habits of amphibians, scorpions and their antiquity. The only fault we wish to find with this delightful volume is that we can detect no arrangement in it, though, as our review shows, some grouping is readily possible.

Zoologists will find much valuable material in this volume, and many suggestions which are evidently not *obiter dicta* but the outcome of an expert's reflection. But the author's power of carrying the reader with him from the familiar to the unfamiliar should make his book welcome to a wider circle—to all interested in the problems of natural history. Our conviction is that there is much more education to be got out of a book like this, if read as carefully as it has been written, than out of many a treatise on mammals. It introduces the student to actual problems and to the method which an expert pursues in studying these. In conclusion, we would direct attention to the beautiful illustrations, *e.g.* of the aye-aye, of giraffes in covert,

of the white-tailed guereza, of a Peking stag, of Père David's Mi-Lou deer, and of the giant tortoise of South Aldabra Island. We hope that this book, which is as stimulating as it is informative, and is far and away above most "popular" natural history essays in its thoroughness, accuracy, and suggestiveness, will have the wide circulation it deserves, and that the author will continue to enrich our scientific literature with many more "zoological essays."

J. A. T.

INFECTION AND IMMUNITY.

Infection and Immunity, with Special Reference to the Prevention of Infectious Diseases. By George M. Sternberg, M.D., LL.D., Surgeon-General U.S. Army (Retired). Progressive Science Series. Pp. ix+293. (London: John Murray, 1903.) Price 6*s.* net.

IN the preface to this volume we find the general statement that "all infectious diseases are preventable diseases," and with this proposition, at least in a general sense, we heartily concur. It follows that there can be no more important factor in the extermination of infectious diseases than the education of the public in their essential nature and modes of spread. For with such knowledge comes not only increased personal precaution against infection, but what is even more important, an enlightened tolerance of sanitary legislation. A volume on "infection and immunity" is thus most suitable for such an undertaking as the Progressive Science Series, and the editor has been fortunate in securing the services of Dr. George M. Sternberg as an expositor of the subject. Dr. Sternberg is well known as one of the pioneers of American bacteriology; he has taken a prominent part in the advancement of public health, and, in particular, of military hygiene in that country; disinfection is, moreover, one of the subjects with which his name is especially associated.

As befits the series to which it belongs, the book is written for the non-medical public, and the writer expresses the hope that it may serve as a text-book for those responsible for the sanitary welfare of public institutions, and even for high schools and colleges. It is divided into two parts, the first of which deals with the general principles of the subject, while the second is devoted to the chief infectious diseases in detail.

The general part contains thirteen short chapters. After a definition and explanation of what is meant by infectious disease, the nature of "disease germs" receives somewhat short treatment. The chapter on "channels of infection" is excellent, and gives a clear idea of the ways in which different diseases spread. Equally good is the chapter on susceptibility to infection, and this is followed by a series of chapters on disinfection and the different agents by which this can be brought about, such as heat, chemicals, and the like. The action of these agents is clearly explained. This part of the book is brought to a close bv three short chapters on immunity and antitoxins. The author is probably wise in having omitted, in a popular work, all discussion of Ehrlich's fascinating theory of the origin of "anti-bodies."

It appears to us that Dr. Sternberg has done this part of his work well, and has furnished a very adequate and readable account of the subject, but it is permissible to doubt whether, in his effort to be concise, he has always made sufficient allowance for the extraordinary ignorance which undoubtedly exists in the mind of the average man as to the essential nature of bacteria and other disease germs. He deals with this matter, which it must be remembered lies at the very root of his whole subject, in five short pages, in which we fail to find any reference whatever to the size of the objects he is describing. Yet it is this very matter of size which is so great a stumbling-block to the average mind in forming a conception of the nature of infection. It would, in our opinion, have been well, in a book which is intended as a text-book for students in high schools and colleges, to have devoted a much larger space to elementary information as to the essential nature of disease germs. In spite of the great accuracy which marks the majority of the writer's statements, there are one or two to which it is possible to take exception. On p. 12 we read that "tetanus is the only disease of man in which spores have been demonstrated"; there are other anaërobic sporeformers which produce disease in man, *e.g. Bacillus oedematis maligni* and *B. aërogenes capsulatus*, while anthrax is unfortunately far from unknown as a human affection. Again, on p. 41, it is stated that alcohol has scarcely any germicidal power; it is true that alcohol cannot kill bacterial spores, but it is almost instantaneously fatal to non-sporing bacteria, at least when these are in the moist condition. These, however, are small blemishes upon what is, on the whole, a very excellent account of a difficult and complex subject.

When we turn from the general to the special part of the book, which occupies another twenty chapters, it is difficult to find anything which is not worthy of unstinted praise. The different infections are taken seriatim, and under each disease we find an admirable and lucid account of its epidemiology and history, of what is known as to the germ which causes it, of the channels by which it spreads, and of the precautions to be taken in combating it. The only important human infectious disease which is omitted is anthrax, if we except syphilis and gonorrhœa, which, from motives of, we think, mistaken delicacy, have been altogether excluded from the book. The author naturally draws much of his statistical information from American sources, and some of it will probably be novel to English readers; for instance, the striking connection between toy pistols and tetanus which has been observed in the United States. The typhoid statistics of American cities will also be viewed with a chastened satisfaction in view of our own more favourable figures, save only for Belfast. It may be regretted that, in treating of diphtheria, Dr. Sternberg has not laid more stress on the importance of

bacteriological examination of the throat and nose in convalescents and in mild sore throats associated with diphtheria epidemics, since there can be little doubt that this is one of the most important sources of danger in the spread of the disease. We note also the unaccountable omission of bleaching powder as a disinfectant for tuberculous sputum; this substance, on account of its solvent powers on mucus, is now well recognised as far superior to any other chemical disinfectant for the purpose.

Those who are acquainted with the Progressive Science Series will be prepared to find the book well printed and got up. The illustrations are few in number, but fairly good, if we except a poor figure of the diphtheria bacillus on p. 193. There is an excellent index.

PHYSIOLOGICAL CHEMISTRY.

Practical Physiological Chemistry. By Dr. J. A. Milroy and Prof. T. H. Milroy. Pp. viii + 201; interleaved. (Edinburgh and London: William Green and Sons, 1904.)

A Laboratory Manual of Physiological and Pathological Chemistry for Students of Medicine. By Prof. E. Salkowski. Translated from the second German edition by Prof. W. R. Orndorff. Pp. ix + 263; with ten figures and a coloured plate of absorption spectra. (New York: John Wiley and Sons; London: Chapman and Hall, Ltd., 1904.) Price 10s. 6d. net.

THE first work under notice is divided into two main portions, the first qualitative, the second quantitative, and the subjects of chemico-physiological interest are treated in a thoroughly practical and systematic manner. The book is written by those who have the necessary knowledge of both chemistry and physiology combined with experience in teaching. The result is a book which can be warmly recommended, and one which is perfectly trustworthy and free from error. It probably includes more than is usually done by students in a practical class with only a limited time at their disposal. It will be necessary for the judicious teacher to select the portions which he regards as essential; the large number of exercises will render this in one sense easy, though in some cases we see there may be a difficulty in choosing what shall be omitted where all is so excellent and so clearly explained. A few plates of important pieces of apparatus, of certain crystals and of absorption spectra are appended. We could have wished to see rather more illustrations of this kind, but this minor defect can be remedied in future editions.

Prof. Salkowski's name is a guarantee in itself that the student of physiological chemistry cannot fail to find much that is excellent and useful in any work he may write, and there is no doubt that this manual, either in the original German or in the present English translation, should find its place on the shelves of any well equipped physiological laboratory. There are certain methods of investigation which Prof. Salkowski has elaborated, and others at which he has particularly worked, some of a complicated nature not usually found in text-books of this kind; it is these which the advanced student or the investigator will find best treated in the present volume

We cannot say that we think the book well suited for students' class work. This is no doubt largely due to the difference between German and English methods of teaching. The systematic practical class which forms such an important feature in the medical schools of Great Britain and America is almost unknown in Germany. There each student works independently in the laboratory at times and for periods which best suit him; he is left to worry out the problems very largely by himself. For the first-rate man this is a first-rate method, but the main bulk of the students do not receive such a thorough grounding as under the English system. The book is far too elaborate for the average student, though not complete enough in all directions for those engaged in original research. The worst fault of the manual is its want of system, and no doubt this arises from the German method or want of method just alluded to. This was particularly striking as we had previously been reading the book by Prof. Milroy and his brother. In this book the rational method is adopted of describing first the detection of the elements in an organic substance, then follow chapters on the three main classes of physiological compounds, carbohydrates, fats and proteids; from this we pass by natural sequence to the foods, the digestive fluids, the excretions and so forth. Prof. Salkowski, on the other hand, starts with the examination of milk, and treats the properties of the proteids as a sort of appendix to the study of that fluid, although the principal proteid of milk is by no means a typical one. Next follows a chapter on muscular tissue, a complex subject for a student only just starting work. A study of gastric juice succeeds this, and a chapter on the blood is sandwiched between that and the study of saliva. The pancreas, the bile, the urine, the liver, bone, fat and egg follow in the order named. Exactly the same thing is seen in each individual chapter; thus in that on the quantitative analysis of urine, we find several methods given for estimating urea, but instead of all coming together, they are separated by sections dealing with the estimation of uric acid and creatinine. We notice also that the book is not thoroughly up to date; this has been remedied in some cases by additions made by the translator, but in other cases, notably in the chapter on muscle, this has not been done. The translation has been well carried out, and Prof. Orndorff has done wisely in omitting the very large portion of the original work which deals with inorganic chemistry.

It is quite right that a translation of Prof. Salkowski's book should have appeared; it is a book with a deservedly high reputation, and has much to recommend it; our criticisms are mainly directed to show that it is not suitable for the average student of medicine on account of the manner in which the subjects are presented to him.

OUR BOOK SHELF.

An Attempt towards a Chemical Conception of the Ether. By Prof. D. Mendeléeff. Translated by George Kamensky. Pp. 51. (London: Longmans and Co., 1904.) Price 2s. net.

This tract, by the famous chemical philosopher whose seventieth birthday has recently been welcomed by the congratulations of the whole scientific world, contains the views of the author of the periodic law with regard to the classification under that law of the recently discovered inert gases. Prof. Mendeléeff places hydrogen at the head of his group i., containing the metals of the alkalis, and makes a special group zero for the inert gases. He gives his reasons for thinking that in this group there are two elements lighter than helium. One of them, of density about 0·2 compared with hydrogen, he identifies with coronium, the source of the characteristic spectrum of the solar corona. Such a gas could not, in accordance with the views first promulgated by Stoney, be retained in the earth's atmosphere, but might be prominent in the higher regions of that of the sun. The other, which he feels justified in taking of extremely low density, he proposes to identify with the ether, which cannot be held by any heavenly body, but is spread through all space. No mention is made of Maxwell's classical objection that the ether cannot be molecular, for if it were, all the energy of the universe would have been transferred into it. He notes incidentally, in connection with the uniform scale and composition of the universe, that most stars the masses of which are known are of the same order of magnitude as the sun. He thinks the condensation of ether towards the massive stars is connected with their intense radiation. He also thinks that the activity of the molecules of radium must be connected with a special condensation of ether around them; for his opinion, stated with reserve and without the certainty which he felt with regard to his views on the periodic law, is entirely against any breaking up of molecules or degradation of elements into other forms, and he therefore rejects the idea of electrons.

The obvious criticism on this is that he thus puts aside all the modern ideas as to the nature of radiation and electric action, and as to physics in general. He thinks, in fact, that the transmission of light will prove a more complex affair than the simple ideas of undulatory propagation on which it is now founded. He thinks that there is only one type of substance, and that a "working hypothesis" type of ether, by which he means a scheme of relations defining a substance with properties different from those of ordinary matter, must be ruled out. He now gives to the world these ideas which he has entertained, because he thinks that there may be little time left to him, and in the hands of others they may come to development. Though much at variance with the modes of thought of students of modern physics, one admires in reading about them the same originality and allusive suggestion that make his "Principles of Chemistry" such an attractive book J. L.

Monographieen aus der Geschichte der Chemie. Herausgegeben von Dr. Georg W. A. Kahlbaum. vii. Heft. (1) Jakob Berzelius. Von H. G. Söderbaum. Nach der wörtlichen Übersetzung von Emilie Wöhler bearbeitet von G. W. A. Kahlbaum. (2) Amedeo Avogadro und die molekular Theorie. Von Icilio Guareschi. Deutsch von Dr. Otto Merckens. (Leipzig: Johann Ambrosius Barth, 1903.)

Dr. Kahlbaum continues to put all chemists under an obligation to him by the successive issue of his valuable monographs on the history of chemistry. The volume before us is of special interest from the fact that the first part of it is a carefully edited translation of an autobiography of Berzelius. The statutes of the Royal Swedish Academy of Sciences require that each newly elected member shall deposit an account of his life and work at the time of his election, and that he shall add to it at stated periods so long as his membership continues. The autobiography before us is the result of that regulation.

It was translated into German, in the first instance, by Miss Emilie Wöhler, the daughter of the eminent chemist, himself a pupil and life-long friend of the great Swedish chemist, with the cooperation of Dr. Kahlbaum, and has been carefully edited and annotated by Prof. Söderbaum. No contribution to the personal history of chemistry that has appeared within recent years surpasses in interest this account by Berzelius of his own life. It is necessarily condensed from the very circumstances in which it was prepared, but all essential features of the career of its author down to 1840, a few years, therefore, before his death, are indicated.

The second monograph, on "Amedeo Avogadro und die Molekular Theorie," is by Prof. Icilio Guareschi, and has been translated into German by Dr. Otto Merckens.

It is a concise account of the rise of molecular theories in chemical and physical science, and of Avogadro's connection with the subject. Incidentally the author deals with the attempts made by Dr. Debus to transfer the credit hitherto associated with the name of the Italian physicist of being the first to indicate the generalisation that equal volumes of gases under comparable conditions of temperature and pressure contain the same number of molecules to John Dalton.

The discussion will be of interest, especially to English chemists. At the same time, it can hardly be said to be convincing or to advance the matter much beyond what is generally recognised as its true position.

De Vi Physicâ et Imbecillitate Darwinianâ disputavit Franciscus Gulielmus Bain, Artium Magister. Pp. 103. (Oxford and London: James Parker and Co., 1903.) Price 2s. 6d. net.

We gather from this work that its author was present as a boy at Darwin's funeral in Westminster Abbey, and had his toe trodden on by the King himself, then Prince of Wales; that the impression produced on him was such that he determined to devote himself in future years to finding out who Darwin was; and that having now succeeded in this laudable endeavour, he cannot visit the British Museum of Natural History and look up at the statue on the staircase facing the entrance without being seized by inextinguishable laughter. "It is this curious incarnation of philosophical poverty and unscientific perversity," he exclaims, "who is elevated into a scientific deity. A theory-blinded and arbitrary denier of Nature's organic and creative power is worshipped as a god in her own temple, every object in which gives the lie to his creed." "The theory of Darwin," he says in another place, "is the *ne plus ultra* of human stupidity. It never could have occurred, except to one incapable of understanding the corollaries of organisation: but once having occurred, it never could have been retained and defended, except by one who was capable of systematically ignoring whole classes of animal organisation, and attending only to instances that prove nothing at all." But Darwin is not the only victim of the author's indignation. Of another name, scarcely less famous than Darwin's, we read that "the ravings of an old woman in a lunatic asylum would be wisdom in comparison with the latest views of this eminent philosopher." What, we may ask, is the cause of this lamentable

collapse on the part of modern men of science? The explanation offered is simple; it is merely that they have learned their method from "that unfortunate being J. S. Mill. I consider the authority of J. S. Mill, and the fact that his 'Logic' and 'Political Economy' were and still are text-books in the University of Oxford, to be a national disaster, and almost equivalent to destroying English intelligence in the germ." Most of the opinions here advanced are of equal weight with the foregoing.

We have let the author of this elegantly printed booklet speak for himself. He abounds in humour both of the conscious and unconscious variety, the latter predominating.

F. A. D.

Bray and Environs. (Bray, Ireland: Published and Sold by Arthur L. Doran, 1903.) Price 1s. net.

Mr. Doran has produced a cheerful and original little guide to the gateway of the Wicklow highlands, and devotes five pages to the botany, geology, and ornithology of the district. In the botanical part he relies on the careful work of Mr. R. Lloyd Praeger ("Irish Topographical Botany"), published by the Royal Irish Academy, but he does not seem to have utilised the admirable new memoir to the Dublin area, prepared by Mr. Lamplugh and his colleagues, when drawing up his geological notes. This Geological Survey publication, including Killiney and many of the places mentioned, should be referred to in the next edition. Messrs. Ussher and Warren may then also appear as authorities in the section on the Irish birds.

But the present book is distinctly attractive, and full of quaintly expressed ideas. Anyone who reads the quotations from the Venerable Bede and Dr. Raverty, the medical superintendent officer of health, set in juxtaposition on p. 5, cannot fail to seek further, confident that he is in pleasant hands. Some of the references owe their sparkle to a touch of irony, such as the unkind mention on p. 11 of Mr. Evans and his votive offerings. Apropos of this, the holy well in Mr. Barrington's land in co. Dublin, with its twentieth century offerings of rags, is mentioned quite naturally on p. 35. Archæologists will note a profound significance in the very simplicity of Mr. Doran's words, and will, it is to be hoped, visit the old-world valley with no other feeling than respect. The present writer was once guided there in the gathering dusk, when Dublin, ten miles distant, seemed to lie, by another measure, thirty centuries away.

The mention of this obscure well, and of the little used but singularly picturesque route round Carrickgollogan (p. 89), will serve to show the perceptive spirit in which Mr. Doran has written for the tourist.

G. A. J. C.

Senior Country Reader. III. By H. B. M. Buchanan, B.A. Pp. viii+293; with 143 illustrations. (London: Macmillan and Co., Ltd., 1904.) Price 2s.

An enthusiastic reception may be predicted for this volume on the part of boys and girls in rural schools who have studied Mr. Buchanan's previous books in this series. There is a surprising amount of information provided, but it is generally presented in a sufficiently interesting manner to avoid weariness on the part of the young reader. The subjects treated—such as manuring, crops, cottage gardens, pigs and poultry—are just those which engage the practical attention of the children out of school, and about which they must know something after leaving school. It is clear from the beginning that Mr. Buchanan writes from personal experience in agricultural pursuits, and this fact will inspire the confidence of the student, while the numerous good illustrations will make quite clear what is being described.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of Nature. *No notice is taken of anonymous communications.]*

A New Mineral from Ceylon.

Since writing last week, I have made further experiments on the cubical mineral, and have myself carefully examined the earth constituents. The statement made last week, that there is only an insignificant amount of thorium present, must be modified. On re-determining the equivalent of the crude oxalate, prepared after the yttrium metals had been separated by treatment with potassium sulphate, it has come out higher than I expected; indeed, assuming the metal present to be a tetrad, its atomic weight is even higher than that of thorium—about 240, as the mean of two closely concordant determinations. The lower equivalents mentioned in the previous letter were determined as fractions of the double potassium sulphate, prepared on a large scale. This high atomic weight points to the presence of unknown elements of higher atomic weight than thorium; indeed, the mineral appears to be of very complex composition. It may be incidentally remarked that the crude oxalate mentioned above must have contained all the cerium group, and if any considerable proportion of the elements of this group is present, the amount of the element with higher atomic weight than that of thorium would have to be proportionately increased. The high radio-activity would point to the presence of the elements obtained from thorium residues mentioned by Prof. Baskerville, which he states to be radio-active.

The equivalent was determined by comparing the weight of oxide from a known weight of oxalate with the percentage of oxalic acid, as determined by titration of another sample of the same preparation.

William Ramsay.

The letter dealing with the composition of a new mineral from Ceylon contributed by Sir W. Ramsay to Nature of April 7 (p. 533) reveals certain discrepancies between the analytical results obtained with this material at University College and those of the Scientific and Technical Department of the Imperial Institute recorded in Prof. Dunstan's letter on this subject (March 31, p. 510). Sir W. Ramsay's results indicate that this mineral is practically free from thoria, whereas those recorded by Prof. Dunstan show that it is particularly rich in this oxide. As Prof. Dunstan is at present abroad, and therefore unable at the moment to comment on Sir W. Ramsay's letter, I may be permitted to direct attention to two observations mentioned by Sir W. Ramsay, which appear to be open to question.

He states that the oxalate obtained from a solution of the mineral is soluble in excess of a solution of ammonium oxalate, and that this reaction excludes the presence of thorium or metals of the cerium group, and points to the presence of zirconium. This inference is not in harmony with the observation recorded by Bahr (*Annalen*, 1864, 132, 231), that thorium oxalate *is soluble* in excess of ammonium oxalate, a fact since confirmed by Bunsen and by Brauner (*Journ.* Chem. Soc., 1898, 73, 951). Further, the solubility of the thorium salt in excess of ammonium oxalate has been used by Hintz and Weber (*Zeit. Anal. Chem.*, 1897, 36, 27) and by Glaser (*ibid.*, p. 213) as a method of separating thoria from monazite and similar minerals. It would appear, therefore, that the principal evidence brought forward by Sir W. Ramsay in support of his conclusion that the mineral contains no thoria in reality supports Prof. Dunstan's statement that it is rich in this oxide. It may be added that the solubility of the oxalate obtained from the mineral in ammonium oxalate had already been observed in this Department.

Sir W. Ramsay appears to be of opinion that the principal constituent of the mineral is the oxide of a new tetravalent element with an equivalent of about 44·7. If this were the case the specific gravity of the mineral would probably be less than 8·2, whereas the determinations of this constant

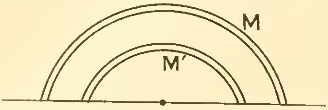
made here and at University College indicate that its specific gravity is about 9, and this figure agrees fairly well with that required for a mineral containing 75 per cent. of thoria.

T. A. Henry.

Scientific and Technical Department, Imperial Institute, S.W., April 11.

Attraction between Concentric Hemispherical Shells.

By the usual method of Legendre's functions I have arrived at the following result. If two thin attracting hemispheres, masses M and M′, radii a and a' ($a > a'$), are placed so that the rims lie in one plane and the centres coincide, the resulting attraction is $\frac{1}{2}$ M.M′/a^2.



From this result we conclude that we may replace M′ by any number of thin hemispherical shells (radii $< a$) subject to the conditions that the density of any shell is uniform, and that the total mass of all the shells is M′.

The result is so remarkable and simple that one looks for an elementary proof.

Perhaps some of your readers may be able to suggest one.

George W. Walker.

Physical Laboratory, The University, Glasgow, March 28.

Mr. G. W. Walker tells me that he has sent to Nature his interesting problem of the mutual attraction between two uniform concentric hemispherical shells, bounded by a common diametral plane. The following elementary solution has occurred to me. Call the outer shell A and the inner B. Now let another hemisphere A′ be added to A so that instead of the hemisphere A we have a complete and uniform spherical shell surrounding B. The attraction between the complete sphere and B is zero, if, as is here understood to be the case, the attraction between the particles follows the Newtonian law. Hence the attraction F of A on B is equal and opposite to the attraction of A′ on B. But the force exerted by A′ on B is obviously equal and opposite to the attraction which would be exerted by A on a hemisphere added to B so as to convert it into a complete spherical shell. Hence the force exerted by A on the inner sphere thus completed would be 2F, and this attraction is the same as that which would be exerted on a particle of double the mass of B placed at the centre. The attraction F of A on B is therefore that which would be exerted by A on a particle of mass equal to B placed at the centre, and the same thing holds for the reaction of B on A. Mr. Walker's result is therefore established.

We may go a step beyond the problem as proposed. Let the diametral plane bounding B, the shells remaining concentric, make any angle with the diametral plane bounding A. Then, by the same process of completing the sphere by adding A′ to A, we see that the attraction exerted by A′ on B is equal, and opposite in direction, to that which would be exerted by A on a hemisphere added to B to complete it in its new position. But the attraction of A on the inner sphere thus completed is equal to that which would be exerted by A on a particle of mass equal to twice that of B situated at the centre, and therefore the whole pull exerted on B by A, in any direction, is equal to the force, in that direction, exerted by A, on a particle of mass equal to that of B situated at the centre.

A. Gray.

The University, Glasgow, April 6.

Curious Formation of Coal.

In Nature of January 14 (p. 250) Mr. Henry Hall describes a vertical deposit of a carbonaceous mineral in a wooden trough into which water from a coal mine had been delivered for three years. This interested me very much, as many years ago I described a similar carbonaceous mineral lining vertical cracks in a sandstone near Whangarei, in New Zealand (*Trans.* N.Z. Institute, vol. iii p. 250, 1871).

I hope that Mr. Hall will make further observations and experiments on this singular phenomenon to see whether he is right in his explanation.

F. W. Hutton.

Museum, Christchurch, New Zealand, February 25.

Photographic Effect of Radium Rays.

It is interesting to note how pictures of the portions in relief on coins, medals, &c., can be obtained by means of radium rays. The coin or other object is placed directly in contact with a photographic plate which is enclosed in an envelope opaque to light. A few milligrams of radium bromide, contained in the usual mica-covered box, are placed some distance above the plate, and the whole left for several days. After development it is found that a clearly defined picture is obtained of the portions in relief on the under sides of the coins. Pictures have thus been obtained of the portions in relief on silver coins (half-crown, sixpence, threepence), also of a name engraved on a mother-of-pearl seal. Ten days was the time of exposure when ten milligrams of radium bromide were placed six inches above the plate, and the coin was a threepenny bit. Ten days also in the case of a half-crown when five milligrams were placed $1\frac{1}{2}$ inches above the plate.

This radium effect was first shown at my last lecture on radium at the College of Science, Newcastle, on January 16, and has been shown at my subsequent lectures.

Henry Stroud.

Durham College of Science, Newcastle-on-Tyne, April 9.

ON THE MEASUREMENT OF CERTAIN VERY SHORT INTERVALS OF TIME.

According to the discovery of Kerr, a layer of bisulphide of carbon, bounded by two parallel plates of metal and thus constituting the dielectric of a condenser or leyden, becomes doubly refracting when the leyden is charged. The plates, situated in vertical planes, may be of such dimensions as 18 cm. long, 3 cm. high, and the interval between them may be 0·3 cm., the line of vision being along the length and horizontal. If the polarising and analysing nicols be set to extinction, with their principal planes at 45° to the horizontal, there is revival of light when the leyden is charged. If the leyden remain charged for some time and be then suddenly discharged, and if the light under observation be sensibly instantaneous, it will be visible if the moment of its occurrence be previous to the discharge; if, however, this moment be subsequent to the discharge, the light will be invisible. The question now suggests itself, what will happen if the instantaneous light be that of the spark by which the leyden is discharged? It is evident that the conditions are of extraordinary delicacy, and involve the duration of the spark, however short this may be. The effect requires the simultaneity of light and double refraction, whereas here, until the double refraction begins to fail, there is no light to take advantage of.

The problem thus presented has been very skilfully treated by MM. Abraham and Lemoine (*Ann. de Chimie*, t. xx., p. 264, 1900). The sparks are those obtained by connecting the leyden with a deflagrator and with the terminals of a large Ruhmkorff coil fed with an alternating current. It is known that if the capacity be not too small, several charges and discharges occur during the course of one alternation in the primary, and that while the charges are gradual, the discharges are sudden in the highest degree. If, as in the present case, the capacity is small, it is necessary to submit the poles of the deflagrator to a blast of air, otherwise the leyden goes out of action and the discharge becomes continuous. Under the blast, the number of sparks may amount to several thousands per second of time. In this way the in-

tensity of the light is much increased and the impression upon the eye becomes continuous, but in other respects the phenomenon is the same as if there were but one spark.

In order to obtain a measure of the double refraction, which is rapidly variable in time, somewhat special arrangements are necessary. At the receiving end the light, after emergence from the trough containing the bisulphide of carbon, falls first upon a double image prism, of somewhat feeble separating power, so held that one of the images is extinguished when the leyden is out of action. The other image would be of full brightness, but this, in its turn, is quenched by an analysing nicol. When there is double refraction to be observed, the nicol is slightly rotated until the two images are of equal brightness. This equality occurs in two positions, and the angle between them may be taken as a measure of the effect. A full discussion is given in the paper referred to.

The finiteness of the angle, which in my experiments amounted to 12°, is a proof that the light on arrival at the CS_2 still finds it in some degree doubly refracting. To obtain the greatest effect the leads from the leyden to the deflagrator should be as short as the case admits, and the course of the light from the sparks to the CS_2 should not be unnecessarily prolonged. The measure of the double refraction, and in an even greater degree the brightness of the light as received, are favoured by connecting a very small leyden directly with the spark terminals, but the advantage is hardly sufficient to justify the complication.

The observations of Abraham and Lemoine bring out the striking fact that if the course of the light be prolonged with the aid of reflectors so as to delay by an infinitesimal time the arrival at the CS_2, the opportunity to pass afforded by the double refraction is in great degree lost, and the angular measure of the effect is largely reduced. There is here no change in the electrical conditions under which the spark occurs, but merely a delay in the arrival of the light.

The optical arrangements which I found most convenient in repeating the above experiment differ somewhat from those of the original authors. The sparks are taken at a short distance from the polarising nicol and somewhat on one side, and in both cases they are focused upon the analysing nicol. When the course is to be a minimum, the light is reflected obliquely by a narrow strip of mirror situated in the axial line, and focused by a lens of short focus placed near the first nicol. This lens and mirror are so mounted on stands that they can be quickly withdrawn, and by means of suitable guidance and stops as quickly restored to their positions. In this case the distance travelled by the light from its origin to the middle of the length of CS_2 is about 30 cm.

The arrangements for a more prolonged course are similar, and they remain undisturbed during one set of comparisons. The mirror is larger, and reflects nearly perpendicularly; it is placed upon the axial line at a sufficient distance behind the sparks. The light is rendered nearly parallel by a photographic portrait lens of about 18 cm. focus, the aperture of which suffices to fill up the field of view unless the distance is very long. In all cases the eye of the observer is focused upon the double image of the interval between the plates of the CS_2 leyden.

The earlier experiments were made at home somewhat under difficulties. For the blast nothing better was available than a glass-blowing foot bellows; but nevertheless the results were fairly satisfactory. Afterwards at the Royal Institution the use of a larger coil in connection with the public supply of electricity, and of an automatic blowing machine, gave steadier sparks and facilitated the readings. An increase of about one metre in the total distance travelled by the light reduced the measured angle from 12° to 6°, so that the time occupied by light in traversing one metre was very conspicuous.

It is principally with the view of directing attention to the remarkable results of Abraham and Lemoine that I describe the above repetition of their experiment, but I have made one variation upon it which is not without interest. In this case the spark is placed directly in the axial line and at some distance behind, which involves the use of longer leads, and therefore probably of a lower degree of instantaneity. The additional retardation is now obtained by the insertion of a 60 cm. long tube containing CS_2 between the sparks and the first nicol, and the comparison relates to the readings obtained with and without this column, all else remaining untouched. The difference is very distinct, and it represents the time taken in traversing the CS_2 over and above that taken in traversing the same length of air. It should be remarked that what we are here concerned with is not the wave-velocity in the CS_2, but the *group*-velocity, which differs from the former on account of the dispersion.

In the above experiments the leyden, where the Kerr effect is produced, is charged comparatively slowly and only suddenly discharged. For some purposes the scope of the method would be extended if the whole duration of the double refraction were made comparable with the above time of discharge. This could be effected somewhat as in Lodge's experiments, where a spark, called the B-spark, occurs between the outer coatings of two jars at the same moment as the A-spark between their inner coatings. The outer coatings remain all the while connected by a feeble conductor, which does not prevent the formation of the B-spark under the violent conditions which attend the passage of the A-spark. The plates of the Kerr leyden would be connected with the outer coatings of the jars, or themselves constitute the "outer" plates of two leydens replacing the jars.

RAYLEIGH.

ENTROPY.[1]

IN NATURE, April 30, 1903, there is an article entitled "Entropy," describing at some length the great practical use which the engineer now makes of the $t\phi$ diagram. Engineers very ignorant of mathematics are able with clearness and certainty to make quantitative computations such as used to task the powers of mathematicians. The problems so easily worked out are very numerous and of a useful, interesting character, and mistakes are not easily made. On the other side of this question, in a notice of Mr. Donkin's translation of Prof. Boulvin's "The Entropy Diagram and its Applications" (NATURE, May 4, 1899), it was pointed out that such books were doing much harm because they made an illegitimate use of the $t\phi$ diagram. Thus I say:—"Of course we may, if we please, say that when steam is released to the condenser, we may imagine the whole change as occurring in the cylinder itself; only we ought to remember that we are substituting a very simple hypothetical process for a very complicated reality, which has almost nothing in common with it. We ought to remember that the very pretty, beautifully complete, cyclic $t\phi$ diagrams, which we obtain from childish assumptions, may get to be looked upon by students, and even by ourselves, as having a real meaning."

It is evident that this misuse of the $t\phi$ diagram is too prominent in Mr. Swinburne's mind, and that he fails to see the real usefulness of ϕ to engineers.

1 "Entropy or Thermodynamics from an Engineer's Standpoint and the Reversibility of Thermodynamics" By James Swinburne Pp. x+137. (Westminster: Archibald Constable and Co.). Price 4s. 6d. net.

He seems to think it easy to study some of those irreversible changes which even the greatest of mathematical physicists have been afraid of, and it is my ungrateful duty to say that he is so ill equipped for the study that he does not comprehend the elementary principles of thermodynamics. Even in the last page of this book he states that thermodynamics "is perhaps the most slippery branch of science there is." He does not seem to know that in the books condemned by him there is an exact study of some irreversible processes, such as the wiredrawing of steam, and that the $t\phi$ diagram lends itself to the study of another irreversible process, the efflux of steam from an orifice.

I take it that this mental phenomenon is not, after all, curious; it is often exhibited when men of great individuality refuse to take the usual point of view, refuse to use words in the exact sense in which other people use them, and create a scientific language of their own which prevents mutual understanding with other people. Mr. Swinburne shows that he has not been able to study the subject from the usual scientific point of view; he has a view of his own much like that of David Deans in religious matters. He says:—"So far as I am aware there is not any work on the steam- or gas-engine in this country that gives a correct definition of entropy." Throughout the book he is everywhere severe upon other writers. "Most treatises on physics, English and foreign, contain incorrect definitions of entropy." We wonder whether any English writer would be particularly pleased in being told that his treatise was held by Mr. Swinburne to be one of the exceptions to this sweeping indictment. But at p. 119 he goes further. "I know of no writer who has tried to give any sort of explanation of what is meant by entropy, except that it is the quantity factor of heat, which is obviously nonsense." "As a young man, I tried to read thermodynamics, but I always came up against entropy as a brick wall that stopped my further progress." Of course it was not the simple idea of entropy with which we try to make all students familiar which stopped his progress. It was Mr. Swinburne's own idea, and any persevering person who manages to get through this book will say that this idea of entropy (or these ideas, for there are many and inconsistent) has not only stopped Mr. Swinburne's progress, but may send any ordinary man into a lunatic asylum.

He has not only a view of his own about thermodynamics, but a painful examination shows that he has several points of view of his own. When he occupies one of these his statements sound quite orthodox, but presently the reader finds that he has completely changed his point of view, and it is exceedingly difficult for even a painstaking reviewer to find out what particular kind of mistake he is making. He is dealing with a mathematical subject, and yet he will not keep to one definition of any of the quantities he is dealing with. Because of certain old terms such as "latent heat" being in use, he seems to think that in thermodynamics we do not use the word *heat* in a definite sense, and from all that the ordinary writers of treatises say he is not sure that to them external work is not heat or chemical energy or electron-flights or the energy of pedesis (pp. 116–117). He himself takes great liberties with the word, and it is quite evident that he believes heat to be something not yet defined and not yet measurable. He sometimes uses the word correctly as meaning heat received by the working substance; but mostly he thinks of heat as something *in* the working substance, and in the majority of such cases what he calls *heat* is what we should call "intrinsic or internal energy" (see pp. 15, 16 and 32, where he uses "heat" and "internal energy" indifferently).

Thus, at p. 124, after some vague phrases which he seems to regard as a definition, he says, "this definition of heat includes the heat that makes things hot, and locomotive heat in general, and it also includes 'latent heat' at constant volume, but only part of any misnamed 'latent heat' that includes any form of external work. It includes latent heat of fusion, of vaporisation apart from external work, and of allotropic modification. What is most heterodox is that it includes chemical energy." It is hardly believable that in a dynamical illustration (p. 108) he should imagine the momentum of a system of two colliding bodies to be increased by the collision, in opposition to the most fundamental, most elementary principle of mechanics. Possibly, as in the case of entropy, he attaches a novel meaning to such a term as momentum. Men who use the *poundal* will be interested in a statement on p. 57:—"But as we have the foot-pound and I think, the poundal, as units of energy. . ." I mention only a few of these curious things without comment, because any adequate comment would almost seem to be a personal insult.

He possesses the power of persuasively stating or implying as a major premiss some general notion of his own and then drawing the conclusions which he wants to draw. For example (p. 136), "The fact that certain units in thermodynamics have no names goes to show that the science is not fully developed. Measurement is an essential in science." In the first part of this he implies the great major:—a science is not fully developed (as no science is fully developed, he means "is badly developed") unless the units of the quantities dealt with have names. Is dynamics badly developed? And is there a name for the fundamental unit of all, the unit of momentum? In the second part he implies that there is no measurement if there are no names for the units. Is there no measurement? Is there not the most accurate measurement of momentum? Is mathematics, is Euclidean geometry a science? What are Euclid's names for the units of length or area or volume? Is astronomy a science? What is the name for the units of force or momentum used by Newton? He immediately proceeds to give as an example that there is no name for differences of temperature according to the absolute Kelvin scale. I think that he does not mean the absolute scale of 1848, because that scale is only of historical importance; he probably means the perfect gas scale invented by Clausius in 1850, which Kelvin showed in 1854 to be independent of the nature of the working substance—well, why can he not be satisfied with the name "degree"? Surely he might have tried to suggest a better name.

The name *Rank* is used by many English speaking people for the British unit of entropy, and it even appears sometimes in examination papers; it is most appropriate. But of course, it would be out of the question to expect Mr. Swinburne to use an existing name, so he wishes to have the word *Claus* used for the British unit of entropy. Rankine used this unit always; it is impossible to imagine that Clausius ever did, or that any person not an Anglo-Saxon ever will. This may merely indicate love for the foreigner. Rankine, Cotterill, Ewing and others have given great pains to perfecting tables of the properties of steam. I know that my students and I spent some months on tables that I myself have published. But the only tables of which Mr. Swinburne makes mention are certain American tables which are obviously incorrect in very important particulars. Reeve's tables are certainly elaborate enough, but every one of the 789

values of the volume of a pound of steam happens to be wrong.

He says (p. 68), "The whole nomenclature of thermodynamics demands re-modelling." Of course we all know that there is much in scientific nomenclature which we should like to re-arrange, but his sweeping denunciations are mostly applied to things that are quite correct. For example, "To measure the heat received at constant pressure or temperature by a 'specific heat at constant pressure' or 'a specific heat at constant temperature' is absurd." The book is full of this sort of statement, delivered with the air of Cato the Censor, accompanied by very clever un-Cato-like gibing such as might be expected in a cheap monthly magazine when the writers are poking fun at scientific persons.

It is often quite impossible to find out the author's line of thought. For example, on p. 50, where he says, "$d\phi$ on the other hand is a complete differential in terms of the ordinates of the state diagram in which $pv = R\theta$, but it is not a complete differential with reference to the external work or piston co-ordinates of the Watt diagram." No reader of this book can fail to notice that Mr. Swinburne has some novel idea as to the meaning of "a complete differential," and I have given much thought to the above cryptic statement hoping that it would throw light upon this interesting matter, but, alas! it still rests in the deepest kind of obscurity. Want of clearness does seem, somehow, to be inherent in his study of this "slippery" subject, for in a footnote (p. 35) he states that "Rankine is not clear about his 'thermodynamic function'" (now called entropy by orthodox persons). "He certainly did not develop the idea of entropy and its relation to waste which forms the basis of this book. No doubt a man of his ability, if he had written on steam engines somewhat later" (Rankine's book on steam engines, published in 1859, is not altogether unknown), "would have been not only perfectly correct, but also clear and unambiguous in his statements and definitions." It is evident that Rankine and Bahram, the great hunter of Omar Khayyam, have something in common, and that in this note Mr. Swinburne departs more than usual from the attitude promised by him on p. 4, that he was not writing "in any spirit of superiority." One is inclined to use the language of Tennyson addressing Bulwer Lytton, "What, you a Timon, . . . !" but it is better not to quote the words; they are omitted from the later editions of Tennyson.

Probably the obscurity is deepest in connection with the meaning of a pv diagram. He says (p. 49), "There is considerable confusion as to the meaning of a pv diagram; that is to say, as to what p means in an irreversible change. As a pv or Watt diagram is . . ." I beg to tell Mr. Swinburne that a Watt diagram is not what anybody means (unless when speaking casually and hurriedly) by a pv diagram; that in thermodynamics we are dealing with a quantity of stuff the v, p and t of which are supposed to be known at each instant, and that if we are not so dealing, if we have irreversible changes, to speak of the pressure of the stuff is to talk nonsense; to speak of a pv diagram is to talk nonsense. He says (p. 71), "If the common statement that the area of a $\theta\phi$ is the same as or proportional to that of the pv diagram were correct" (it certainly is correct) "there would be . . ., and all steam and gas engines would have an efficiency of $(\theta_1 - \theta_2)/\theta_1$." I can explain the meaning of this very incorrect statement only on the assumption that Mr. Swinburne does not know the cycle of a steam or gas engine. The context shows that he means by θ_1 and θ_2 (at all events in the case of a steam engine) the highest and lowest temperatures. Now even on the Rankine cycle of the perfect steam engine the above efficiency is not reached, and any other steam engine cycle, even if reversible, known to us, has a smaller efficiency that the Rankine cycle.

I think that most of Mr. Swinburne's mistakes arise somehow from a belief that it is easy, or ought to be easy, to explain exactly what occurs in irreversible processes, and if without attacking other people he set himself to such a study, even so ill equipped as he seems to be for the task, he would have the sympathy of all students of thermodynamics. Most certainly it would be dangerous for me to criticise him, for I myself have given hostages to fortune in that some six years ago I published an attempt to study what occurs when steam is released from a cylinder, and the other irreversible operations in a steam cylinder. The late Prof. Fitzgerald commended my attempt, but I must confess that although I gave much thought to the matter I published it with some expressions of dissatisfaction. I must, however, say something about Mr. Swinburne's discovery, which resembles the famous pill to prevent earthquakes, namely, his $\theta\chi$ diagram. If θ is absolute temperature, $\theta.d\chi$ is the increase of energy "in the form of heat in the body itself." Close study shows that he here means the heat energy received by the body during a small change minus the work done in the body's expansion. Well, this is what we orthodox people call intrinsic energy dE. We may put it, then, in this way: if dH is the heat received by a body the p and θ of which are the same throughout,

$$\theta d\chi = dE = dH - p.dv,$$

or

$$d\chi = dE/\theta = dH/\theta - p.dv/\theta.$$

Now Mr. Swinburne uses a $\theta\chi$ diagram to show the changing state of the water-steam stuff, and so means what we mean when we say that $d\chi$ is a complete differential. As, to Mr. Swinburne, the subject is, as he himself says, "slippery," I would ask him to take no difficult case, no irreversible case, but to take any pv diagram of any steam engine, and he will find that he cannot close his cycle in a $\theta\chi$ diagram. In fact, when p and v and θ and E and ϕ all return to their old values at the end of a cycle χ does not do so. This happens to be a matter of mathematical proof, for if $dH = k.d\theta + l.dv$, Mr. Swinburne's $d\chi$ cannot be a complete differential unless l is equal to p. That is, the substance must be one the intrinsic energy of which is a function of its temperature only. A perfect gas has this property. Changing water-steam certainly does not possess it. If his discovery is found to be worthless in all cases where we have a pv diagram where we can test its value, why should we think it of worth for irreversible cases of which we know so little?

Probably the most curious of his conflicting notions about entropy is what he develops in chapter iv. When heat is being conducted along a bar or through a plate from furnace to water, he speaks of the great growth of entropy. It is useless to point out to him the importance of keeping to one definition. But surely even he must see that there is something quite inconsistent in two of his ideas. First, that if the state of a quantity of stuff is known, its entropy is known. This is, of course, a mere statement of the second law of thermodynamics, and he occasionally admits its truth. Second, a thin slice of bar which is conducting heat keeps in the same state all the time, and yet it is losing entropy continually, that is, it is giving out more entropy than it receives. He introduces a new idea quite inconsistent with his other ideas, that entropy is something which may travel from one body to another. He grudgingly allows us to talk of heat being transferred, or any kind of

energy being transferred, but cheerfully introduces this new idea of a peripatetic entropy.

The fact is, so soon as a man departs from the mathematical definition of a quantity like entropy, he is in danger of all sorts of inconsistency. Conduction of heat implies that temperature is *not* constant in the thinnest slice of a bar or portion of fluid, and we have no right to speak of the entropy of a portion of stuff or of its pressure or of its temperature unless it is in the same state throughout. It is obvious that underlying Mr. Swinburne's statements throughout this book it is not always the entropy of a quantity of stuff that he thinks of; it is often the entropy of a quantity of heat, just as if we said:—Heat H in the furnace at a high temperature θ_1 has entropy H/θ_1; in the water of the boiler θ_2 is the much lower temperature, and the entropy H/θ_2 is much greater than in the furnace, and so on. Wherever there is conduction or any kind of irreversible operation there is a growth of entropy. This sort of representation is familiar to all users of the $\theta\phi$ diagram, but they know how to put the matter quite clearly (see NATURE, April 30, 1903) without using terms in a wrong sense, without confusion of ideas, without condemning wholesale what other men have written, without contradicting the fundamental laws of thermodynamics.

This notice may seem to be unduly long; I may seem to waste valuable space in NATURE and give undue importance to an unscientific book. But unhappily it is necessary. Mr. Swinburne's vague denunciations of writers on thermodynamics in letters and articles to the engineering papers have done a great deal of harm to young engineers, and I am peculiarly bound to the very ungrateful task of pointing out his mistakes. A writer who proves that the earth is flat deserves no notice, for he can do no harm, but although Mr. Swinburne's heresies are just as unscientific, just as absurd, they must be noticed and condemned. He uses a jargon which sounds quite scientific to a young engineer; he involves a reader in his mistakes so persuasively that if this reader is an earnest young engineer I feel sure that he must get utterly discouraged with the idea that the study of thermodynamics can be of any use to him. Probably the best of antidotes to this poison are the two articles in NATURE referred to at the beginning of this notice.

JOHN PERRY.

AGRICULTURAL EDUCATION AND RESEARCH IN INDIA.

THE last mail brings an issue of the Allahabad *Pioneer*, containing the resolution of the Government of India regarding the establishment of an agricultural college and research station at Pusa, in Bengal. It will be remembered that Mr. Henry Phipps gave a sum of 20,000*l*. to be devoted to whatever object of public utility (if possible in the direction of scientific research) the Viceroy might prefer, and on the decision to create with this sum an imperial centre for agricultural investigation Mr. Phipps increased his donation by another 10,000*l*. It was at first proposed to make the existing laboratory at Dehra Dun the nucleus of the new work, but the superior advantages offered by the estate at Pusa have resulted in the decision "to make Pusa the headquarters of the Imperial Agricultural Department, and to establish there the laboratories required by the experts, combining with them farms which will offer every convenience for practical work, and an agricultural college." For this purpose the estate has been transferred from the Government of Bengal to the Government of India, and the existing staff at Dehra Dun will move to Pusa when the laboratories are ready, which is expected to be in September, 1905.

The agricultural college is intended to serve not only Bengal, but the whole of India, and to provide a supply of trained men, who "will be required to fill posts in the Department of Agriculture itself, such as those of assistant directors, research experts, superintendents of farms, professors, teachers, and managers of court of wards and encumbered estates."

At the research institute it appears that the staff is to consist of two chemists, one being specially concerned with bacteriology, two botanists, one cryptogamic, the other "biological," and an entomologist.

This scheme ought to grow into an institution of the utmost value to India, a country which is full of agricultural industries, involving great interests, yet proceeding wholly by rule of thumb tempered by occasional analyses performed in London. Systematic investigations of the conditions of the industry on the spot have been wanting except latterly among the tea-planters of Ceylon and Assam. Indigo growing affords a case in point; for years it was obvious that the natural product was going to meet with severe if not ruinous competition, yet nothing was done until the artificial indigo had reached the position of being able to undersell the Indian article, then at last a chemist and a bacteriologist were hurried out to try to save the failing industry. But how can the most eminent scientific man be expected to descend from Europe like the god from the car and revolutionise an old and complicated business at sight?

The new institute at Pusa will be well situated among some of the best agricultural developments in India, so that the scientific staff will have an opportunity of learning where their skill can be of service to the cultivator, and of trying to keep this or that industry in a healthy condition instead of being called upon to resuscitate it when *in extremis*. There may be even now a chance for the grower of indigo if only he is given some of the systematic scientific effort which has hitherto been the monopoly of his competitor.

NOTES.

PRESS messages from New York contain an account of the discovery, by Prof. Baskerville, of the University of North Carolina, of two new elements possessing somewhat remarkable properties. By distilling thorium oxide in a quartz tube with carbon and chlorine there are produced a greenish condensable vapour to which the name berzilium is given, and a crystalline, pinkish substance which adheres to the quartz tube and is named carolinium, whilst a certain quantity of thoria remains unchanged in the tube. Prof. Baskerville has at his disposal 5 grams of carolinium and 2·5 grams of berzilium, presumably in the form of volatile chlorides. In a lecture before the Chemists' Club Prof. Baskerville exhibited the two elements in a darkened room, and showed that each of them is capable of shedding an illumination through tubes of copper, brass, iron and glass, all covered with cloth. Further investigations are in progress, in which Prof. Zerban, of Berlin, will cooperate.

PROF. R. W. BOYCE, F.R.S., has been appointed a special advisory member of the committee of the African trade section of the Liverpool Chamber of Commerce on matters relating to health and sanitation.

REUTER'S Agency is informed that the British Antarctic vessel *Discovery*, with Captain Scott and his staff, is not

likely to return to England before the autumn. It is expected that the relief ships *Morning* and *Terra Nova* will sail direct for home.

A Reuter message from Montreal, dated April 7, states that "The Board of Trade has decided to take steps to second the proposal of the London Chamber of Commerce to organise tours throughout Canada for English university graduates, as moved at the Congress of Chambers of Commerce held last summer."

The opening meeting of the Sociological Society will be held at the School of Economics and Political Science, Clare Market, W.C., on Monday next, April 18, when Dr. E. Westermarck will read a paper on woman in early civilisation. The following papers have also been arranged:— May 16, Mr. Francis Galton, F.R.S., on eugenics: its definition, scope and aims; June 20, Prof. E. Durkheim and Mr. V. Branford, on sociology and the social sciences; July 18, Mr. Patrick Geddes, on civics as applied sociology.

M. de Fonvielle writes that at a recent meeting of French meteorologists in Paris M. Bouquet de la Grye delivered an address in which he referred to the extent of the work of the French meteorological service. The number of stations in connection with the service sending observations twice daily to Paris is 126, of which 72 are in foreign parts and 7 are mountain observatories. During 1903 it appears that sixty storms visited the coasts of France, of which fifty were announced by telegrams. Ninety per cent. of the storm warnings published in the Press were verified. During the same year the meteorological kites reached the great height of 5960 metres. The conclusion of the speech of M. Bouquet de la Grye was devoted to the work of Sir Norman Lockyer on the connection between solar and terrestrial phenomena.

Some of the effects produced by the high altitudes traversed by the Tibet expedition were referred to last week (p. 540). Imperfectly cooked food caused indigestion among the troops, and congealed oil led to difficulties with the magazines of the rifles. Commenting upon these points a correspondent of the *Times* remarks:—"Any tiro in physical science could have told the military authorities that at 15,000 feet above the sea oil ceases to be a lubricant and becomes a clog. Also that the temperature of water boiling in an open vessel falls roughly two degrees Fahrenheit for every 1000 feet you ascend. He could also have given the remedy in both cases. Our men ought to have had pure glycerine to lubricate the locks of their rifles and Maxims. They ought to have had cooking-pots with air-tight lids furnished with simple safety valves blowing off at a pressure of 15 lb. on the square inch. Then they would have had no trouble either with rifles or cooking. The tiro could also have pointed out that the elasticity of springs, and especially of certain kinds of spring, is greatly affected by temperature, and that it would have been well to test the Maxims at such temperatures as they would certainly have to encounter."

The Deutsche Seewarte has made a very useful addition to its international ten-day weather report by the issue of charts showing, for 8h. a.m. each day, the distribution of atmospheric pressure over the North Atlantic between the continents of North America and Europe by means of isobaric lines, with arrows denoting wind direction and force. The positions of the areas of high and low barometric pressure are plainly shown, and are the more interesting and valuable from the fact of the publication of the charts so soon after date. The supplement to the weather report of April 1 last, for instance, contains the daily isobaric charts for March 1–10, together with tabular statements as hitherto of the ten-day results of pressure, temperature, and rainfall at stations in North America, Europe, and intermediate islands.

In several papers descriptions have recently appeared of a "novel method of electric traction," in which the current is employed to generate steam in an ordinary locomotive boiler by means of an electric furnace. The system is obviously very wasteful of power from a thermodynamic point of view, and those who wish to learn what the waste would amount to under actual conditions will find a letter on the subject, by Mr. Arnold G. Hansard, in *Knowledge and Scientific News* for April.

An interesting account of the Imperial University of Tokyo is contributed to a recent number of the *Popular Science Monthly* by Mr. Naohidé Yatsu. It will probably interest European readers to learn that "in so remote a time as the eighth century a university had already been established in Japan that included such modern divisions as schools of medicine, ethics, mathematics, history, and that some of the text-books employed at that remote period dealt with such subjects as the diseases of women, *materia medica* and veterinary surgery, types of text-books which appear to have been unknown in European countries until about 1000 years later."

A recent number of the *Revue générale des Sciences* contains a short note on the Arnold electropneumatic system of traction, the object of which is to overcome the difficulties connected with electric traction by alternating currents consequent on the variable velocity of the train. The motor in this case consists of a stator and a rotor, of which the latter is directly fixed to the axle of the wheel. The stator is, however, free to rotate, but by doing so it operates on a condensing pump connected with an air engine, which in its turn works on the wheels. When the train is running at a speed corresponding to synchronism, the stator remains at rest, and the apparatus then works like an ordinary alternate current motor. In starting the train, on the other hand, the pneumatic action is brought into play, the necessary synchronism being maintained by the rotation of the stator.

A paper has been communicated to the Vienna Academy by Dr. N. Herz on a generalisation of the so-called "problem of eight points." The problem may be stated as follows:—If from any four points the twelve angles subtended by four objects are measured, or if from any three points the twelve angles subtended by five points are measured, then the relative positions of the eight points are completely determined. The importance of the problem is obvious in connection with the photographic survey of unexplored districts, as by comparing the relative positions of the same five objects on three different plates, a plan of the region can be constructed with greater precision than is possible with sketches.

The catalogue of additions to the library of the Botanic Gardens, Kew, received during 1903, forms appendix ii. to the *Bulletin* and is printed as usual on one side of the paper only, so that the titles may be cut out if desired.

A pamphlet dealing with diseases of the sugar cane has been received from the Imperial Department of Agriculture for the West Indies. This contains the substance of three lectures delivered by Mr. Lewton-Brain, the official mycologist in Barbados, in which special consideration was given to the rind and root diseases. As Sir Daniel Morris

mentions in the preface, the rind fungus caused the damage to the canes in 1895, but this was overcome by the introduction of a resistant variety. The root disease caused even greater disaster last year, and as so far no variety has been obtained which is resistant to its attack, the planter has to adopt more laborious and continuous measures of dealing with it.

JUDGING from the fact of its having reached a third edition, Dr. Hoyle's "Handy Guide" to the Manchester Museum appears to be highly appreciated by the class of visitors for which it is intended.

DR. R. W. SHUFELDT, in the January number of the *American Naturalist*, discusses the osteology and systematic position of the grebes and divers (Pygopodes). The author maintains his former opinion as to the probability of these birds being the descendants of toothed divers more or less closely allied to the American Cretaceous Hesperornis, the grebes exhibiting the most marked traces of this relationship. As the flightless Hesperornithidæ themselves are doubtless the descendants of flying types, so, in the author's opinion, our modern grebes and loons may, if they survive long enough, become in the course of ages modified into forms incapable of flight.

THE biological articles in the January number of the *Journal* of the Straits Branch of the Royal Asiatic Society include an account of new Malayan plants by Mr. H. N. Ridley, a list of Bornean butterflies by Mr. R. Shelford, the description of certain Hymenoptera in the Raffles Museum at Singapore by Mr. P. Cameron, and notes by Mr. G. B. Cerruti on the Sakais of Batang Padang, Perak. Although it may be doubtful whether the forest aborigines whom the Malays designate Sakai are really true Negritos, Mr. Cerruti's essay demonstrates that they are certainly of a very low grade, being destitute of either written records or of signs to represent language.

IN the *American Naturalist* Mr. R. S. Lull continues the "symposium" on the adaptive modifications of mammals, taking for his text those induced by the exigencies of a cursorial mode of existence. Naturally the greatest modifications occur in the limbs, but correlated with this is also an elongation of the head and neck in long-legged types. Adaptation for speed is further exhibited in the moulding of the shape of the body so as to present the minimum amount of resistance to the air, as well as in increase in heart and lung capacity to meet the extra expenditure of energy. Finally, in the jumping forms we meet with an increase in the length and weight of the tail, which has to act as a counterpoise. As regards the feet, a reduction in the number of digits is a frequent feature, more especially among the hoofed forms, where the culmination in this respect is attained by the existing members of the horse tribe and certain representatives of the extinct South American Proterotheriidæ, both of which are monodactyle.

ACCORDING to the report of the Marine Biological Association of the West of Scotland for the past year, which is illustrated with a portrait of Sir John Murray, the station at Milford has undergone considerable enlargement and extension through the liberality of Mr. J. Coats, jun. Notwithstanding the building operations, which commenced in May last, the work of nearly all the departments shows an excellent record for the year. It is satisfactory to learn that Sir John Murray, who has filled the office of president for the last three years, has offered three prizes of 50*l*. each for papers on that number of subjects connected with the work of the association. The prizes are given in memory of the late Mr. F. P. Pullar, who was long associated with Sir John in the bathymetrical survey of the Scottish lochs, and who lost his life in an ice accident in February, 1901. "These prizes are open for competition to investigators from any part of the world who conduct observations in the several subjects at the Millport Marine Station, and who produce at any time before January 1, 1905, papers which, in the opinion of a committee of three scientific men, to be nominated by the Association and by Sir John Murray, shall be deemed to be of sufficient value to merit publication."

PROF. LOEB, whose work on artificial parthenogenesis is well known, has recently succeeded in causing the fertilisation of the egg of the sea-urchin by the sperm of the starfish. This interesting result has been brought about by altering the constitution of the sea-water, preparing an artificial sea-water ($NaCl$ 100, KCl 2·2, $MgCl_2$ 7·8, $MgSO_4$ 3·8, $CaCl_2$ 2 in half gram-molecular solution), and rendering it slightly alkaline with caustic soda (0·3–0·4 c.c. of deci-normal $NaOH$ per 100 c.c. of the solution). In this some 50–80 per cent. of the sea-urchin (*S. purpuratus* and *S. franciscanus*) eggs may be fertilised in a short time by the addition of living sperm of a starfish (*A. ochracea*). The eggs form a membrane of fertilisation, and at the proper time segment and develop into swimming larvæ. The ultimate development of these hybrid larvæ has yet to be observed (University of California *Publications*, Physiology, vol. i., No. 6, 1903).

THE problem of the further development of Halteridium, a blood parasite of birds, and its definitive host has until now remained unsolved. Schaudinn has recently published an exhaustive paper on the cycle of development of a Halteridium of the little owl (*Athene noctua*). He traces the further development of the parasite in the middle intestine of the common gnat, *Culex pipiens*, and finds that in this insect it becomes a well defined flagellated organism or trypanosoma. The male and female gametes conjugate in the mosquito, and certain of these cells develop into asexual trypanosomes, others into thick trypanosomes having female characters, and others into small slender trypanosomes having male characters. The parasites congregate in the poison-gland of the insect, whence they are injected into a fresh host when it bites. The trypanosome forms then attack the red blood cells, enter these, and lose their flagella, becoming the intra-corpuscular Halteridium forms once more. Schaudinn re-names the parasite *Trypanosoma noctuae* (*Arbeit. aus d. kaiserl. Gesundheitsamte*, xx., Heft 3).

IT is quite clear from the report of the council and proceedings of the Hampstead Scientific Society for the year 1903—a copy of which has been received—that the association is doing good and useful work, particularly at meetings of sections, of which there are three—astronomical, natural history, and photographic. The number of members now stands at 315, a total increase of 29 members since the last report.

THE first part of "A Technological and Scientific Dictionary," edited by Messrs. G. F. Goodchild and C. F. Tweney, and published by Messrs. George Newnes, Ltd., has been received. It consists of 64 pages, and contains articles, definitions, and terms of science and technology in subjects the names of which begin with letters from A–B(ow). The dictionary is to be completed in fifteen parts, and each part costs a shilling net.

MESSRS. HARRY W. COX, LTD., have sent us a copy of a new illustrated catalogue of their induction coils, inter-

rupters, X-ray tubes, apparatus for fluoroscopy and radiography, primary and secondary batteries, high frequency apparatus, dynamos, and other instruments. Many useful details as to the various instruments are described; and the catalogue also contains about thirty pages of practical hints to beginners, which will prove of assistance to those who propose to work with Röntgen ray, high frequency and electromedical apparatus.

A SECOND edition of Prof. Stanislas Meunier's volume on "La Géologie expérimentale" has been published by M. Félix Alcan, Paris. The work contains many ingenious and instructive experiments illustrating the phenomena of geology and physical geography, and most of them can be performed successfully with very simple appliances. The original edition was reviewed in NATURE in August, 1899 (vol. lx. p. 388), and the new volume, though dealing essentially with the same subjects, is differently arranged, and includes much new matter.

PROF. W. OSTWALD'S "Grundlinien der anorganischen Chemie" (Leipzig: Engelmann; London: Williams and Norgate), which originally appeared in 1900, and was reviewed in NATURE of April 11, 1901 (vol. lxiii. p. 557), has reached a second edition. The work provides students with a text-book in which chemistry is developed from the outset in accordance with modern theoretical knowledge. The book attracted immediate attention, not only on account of the author's eminence as a teacher and investigator, but also because of its plan of treatment. The new and revised edition will certainly meet with the same success as the original work, of which the edition of four thousand copies was exhausted in about three years.

A SECOND edition of "Towers and Tanks for Waterworks," by Mr. J. N. Hazlehurst, has been published by Messrs. Wiley and Sons (London: Chapman and Hall, Ltd.). The book deals with the design and construction of metal stand pipes and tanks for storing up water at a sufficient elevation to provide adequate pressure for its proper distribution. A review of the original volume appeared in NATURE of September 26, 1901 (vol. lxiv. p. 525). Another work just published by Messrs. Wiley is the eighth edition of "The Theory and Practice of Modern Framed Structures," by Messrs. J. B. Johnson, C. W. Bryan, and F. E. Turneaure. This comprehensive volume is designed for use in technical schools and by engineers in professional practice. A large part of the original work has been re-written, and many changes have been made in other parts to bring them into close touch with modern practice. The new designs and improvements in methods of description, the practical character of the text and illustrations, and the use made of graphical representation, combine to make the volume one to which all students of engineering should have access.

A DETERMINATION of the molecular weight of solid phosphoretted hydrogen, described by Messrs. Schenck and Buck in a recent number of the *Berichte*, has shown that this compound has a more complex formula than that which has usually been assigned to it. The method employed consisted in determining the depression of the freezing point of a solution in yellow phosphorus, and the results obtained indicate that the molecular weight corresponds with the formula $P_{12}H_6$, and not with the simple formula P_4H_2.

M. GUILLAUME sends a correction of the note on nickel-steel which appeared in our issue of March 24 (p. 496); the coefficient of expansion of γ-iron is greater than that of α-iron, and all non-magnetic steels in which the iron is retained in the γ form, such as Hadfield's manganese steels, retain the large coefficient of expansion characteristic of this modification of iron. M. Guillaume adds that "the function of nickel in the alloys is essentially to unite into a single change the two transformations of pure iron, and thus, as M. Osmond has shown, to eliminate altogether the β variety; then, on account of the state of mutual dissolution in which the two chief constituents of the alloy are found, to create an equilibrium varying with the temperature, such that the transformation of α into γ iron and conversely takes place over a considerable interval instead of being concentrated at a single point as in pure iron."

A SOMEWHAT striking observation is recorded by Dorn in the *Physikalische Zeitschrift*. A tube of alkali-free Jena glass, containing 30 mg. of radium bromide, had been sealed up on December 3, 1902, in order that some experiments might be carried out on the supposed loss in weight of radium salts. Six months later, on May 27, 1903, it was desired to open the tube. This was done by means of a triangular file, but as soon as the metal touched the surface of the glass the tube was pierced by an electrical spark so bright as to be clearly visible in broad sunlight close to the window, whilst the sound was mistaken by an assistant in the room for the discharge of an induction coil. It is suggested that the retention in the tube of the positively charged α particles and the escape of the negatively charged β particles must have set up a potential difference between the inside and the outside of the tube so great that it was ultimately able to pierce through 0·3 mm. of glass.

THE electrochemical behaviour of radium is discussed by Mr. Alfred Coehn in a recent number of the *Berichte*. From the thermochemical data it would appear that the separation of the metal would be increasingly difficult in the series Ca, Sr, Ba, but when a mercury kathode is used the voltage required is greatly reduced owing to the energy liberated in the formation of an amalgam, and the order in which the metals separate is reversed. Thus it requires 0·2 volt more to separate strontium than barium, and 0·25 volt more to separate calcium than strontium; if the series were continued radium should require 0·3 or 0·4 volt less than barium, and metallic radium can actually be precipitated by barium amalgam. Owing to the very small proportion of radium in the crude bromide it is impossible to effect a sharp separation of the metals except with an impracticably small current density, but a considerable concentration may be effected by this method. It is of interest to note that freshly prepared (unoxidised) radium amalgam, like the salts of the metal, only slowly attains its maximum activity, whilst the silver anode, which at first exhibits a very powerful induced activity, soon becomes altogether inactive.

THE additions to the Zoological Society's Gardens during the past week include a Maccarthy's Ichneumon (*Herpestes fulvescens*) from Ceylon, presented by Mr. Arthur M. Dowson, R.N.; a Leadbeater's Cockatoo (*Cacatua leadbeateri*) from Australia, presented by Mr. W. A. Ridley; a Cocteau's Skink (*Macroscincus cocteaui*) from the Cape Verde Islands, presented by Mr. — Hastings; two Painted Frogs (*Discoglossus pictus*), European, presented by Dr. F. G. D. Drewitt; three Jays (*Garrulus glandarius*), British, purchased; an Eland (*Orias canna*), a Mouflon (*Ovis musimon*), eight American Timber Wolves (*Canis occidentalis*), a Muscat Gazelle (*Gazella muscatensis*), born in the Gardens; a Black Swan (*Cygnus atratus*), bred in the Gardens.

OUR ASTRONOMICAL COLUMN.

THE GREENWICH SECTION OF THE ASTROGRAPHIC CATALOGUE.—At the meeting of the Royal Astronomical Society held on March 11, the Astronomer Royal gave the chief particulars concerning the first part of the Greenwich section of the International Astrographic Catalogue, which is now quite ready for publication. The whole section comprises the region between declination $+64°$ and $+90°$, whilst the part soon to be published deals with the region $+64°$ to $+72°$ inclusive, and covers 1077 square degrees, containing 80,000 stars. From the results already obtained it is computed that the complete Greenwich contribution to the catalogue will include about 179,000 stars.

In his communication Mr. Christie stated that the number of stars per square degree increases with the declination until a maximum is reached at $+76°$; this effect is probably due to the Milky Way. A discussion of the relative magnitudes of the stars obtained on the catalogue plates has shown that stars down to at least the eleventh magnitude appear on negatives which received six minutes' exposure (the *Observatory*, April).

THE COMPUTATION OF ELEMENTS FOR AN ANNULAR ECLIPSE.—A paper by Herr Zwack, secretary of the Philippine Weather Bureau, issued as a supplement to the *Bulletin* for August, 1903, explains the method used in computing the elements for an annular eclipse of the sun. The method of successive approximations is illustrated by a detailed explanation of the procedure employed in computing the elements for the annular eclipse of March 17, 1904, as seen at San Domingo (Batanes Islands) and Manila (Luzon).

RAPID CHANGES IN A SUN-SPOT.—In a communication to No. 343 of the *Observatory*, Mr. Denning gives particulars of some rapid changes which he saw take place in a sunspot on January 22. The spot was one of four in the north-west quadrant, and it had a triple umbra. Whilst Mr. Denning was observing, one of these umbræ became greatly modified, and two new small spots appeared. Mr. Denning suggests that much valuable information regarding the behaviour, the formation, and the cyclonic conditions of spots might yet be obtained by more persistent observations. Solar observations generally terminate when the positions and forms of the spots have been recorded, and from these records valuable knowledge as to the period and loci of sun-spots has been deduced, but for about the last forty years very little consistent work has been done in *persistently* noting the minute yet constant changes which take place in the disturbed regions about spots.

Mr. Denning further suggests that daily observations extending over several hours would probably produce results which would completely justify the outlay of the time necessary for making them.

PHOTOGRAPHIC OBSERVATIONS OF BORRELLY'S COMET (1903 *c*).—A paper by Mr. Sebastian Albrecht in No. 2, vol. xix., of the *Astrophysical Journal* describes thirty-one negatives of the comet 1903 *c*, taken at the Lick Observatory, between June 22 and August 18 inclusive, with the Crocker telescope and the Pierson camera respectively.

The negatives show two tails, one about 10° in length and generally straight, the other about 1°.5 in length and much curved. In addition to these, occasional streamers developed and were generally fairly persistent, narrow and straight, sometimes emanating from the main tail, sometimes from the coma. The modifications in the main tail which have been previously noted by the observers at the Nanterre and Yerkes Observatories are very prominently shown on the negatives secured at Lick on July 23, 24 and 26, three beautiful reproductions of which accompany Mr. Albrecht's communication. The negative of July 23 shows an entirely new tail, having a length of about 4° and an angular width of about 4°.6, issuing from the head and preceding the radius vector by about 6°. This feature is not shown on the negative secured on July 24.

The paper also contains a discussion of the various changes, together with several tables giving the dimensions and positions of the tails and streamers which are shown on the negatives.

THE EVOLUTION OF EMPIRE.

NO matter what may be the subject of investigation, the process of evolution always appears as a progressive movement from the simple to the complex, from homogeneity to heterogeneity. It is so in zoology when the simple self-contained cell by segmentation sets out on the upward path of organisation; it is so in sociology when the primitive homogeneous community through division of labour takes the first step in civilisation; it is so in art; it is so in letters; it is so in all the multifarious domains of human experience, and the evolution of empire forms no exception to the rule. In every case the method is the same. The course pursued is a zig-zag or spiral, which tends now towards difference and again towards agreement; there is a constant ringing of the changes between variation and integration, and the goal is ultimately reached under the simultaneous or alternate influence of the forces of separation and union.

In the cooperation of these apparently antagonistic factors towards a common end lies the paradox of all ages. It is the riddle of the sphinx which each succeeding generation must solve or succumb. Ancient philosophy made many good guesses at the truth. Herakleitos, 500 B.C., wrote, "Opposition unites; from what draws apart results the most beautiful harmony; all things take place by strife." Empedokles a few years later spoke of creation as the product of love and strife, "From these come all things that are or have been or shall be." Still later Plato, referring to the teaching of Empedokles, wrote, "Being is many and one and is controlled by hate and love; borne apart it is always borne together." The Persians personified the antithesis under the dualism of Ormuzd and Ahriman, the powers of light and darkness. So universal is this concerted antagonism that it seems to be inherent in the very essence of things, and is doubtless a manifestation of the polarity which pervades creation. Even in music, the most fugitive and intangible of arts, the process of evolution through difference and agreement is clearly marked. The simplest music is in unison—to this succeeds a differentiation into various parts, and these are ultimately blended in harmony. So that the sequence, here as elsewhere, is from unity, through difference, up to union, the reintegration being more complex and in a far higher plane of performance than the uniformity from which it was evolved.

It was left for Darwin to focus the vague surmises of his predecessors and to demonstrate the systematic operation of variation and integration in the production of new forms. Science since his day has been occupied in applying his theory to fresh fields of inquiry, and in no department has a richer harvest of results rewarded the investigator than in tracing the application of the laws of evolution in the development of communities.

Comte was of opinion that the most fruitful results would follow the process of sociological suggestion followed by zoological verification, and striking confirmation of the efficacy of this method is found in the fact that Darwin got the first hint of his discoveries from contemplating the dilemma of Malthus with regard to population. This sequence is most rational, for selection has arrived at a far greater degree of finality and excellence in living forms than in social organisms. In each case nature proceeds by continual invention and experiment and ruthless discarding of failures, but in zoology the problems are simpler, because the factors are more determinate than in sociology. The rigorous dynamics of blood pressure and the limitation of speed of nerve currents are fixed conditions which prescribe the economic size of the individual. These conditions have existed since the beginning of the world—the necessity of rapid reaction to stimulus and of vascular efficiency has caused the elimination of the unwieldy antediluvian monsters in favour of the marvellously agile and tensely arterialised modern carnivora.

In sociological problems the hand of nature is still that of the apprentice. New conditions as to communication and transport have rendered previous conclusions nugatory. The difference in speed of communication to-day as compared with 300 years ago is illustrated by the fact that the news of Queen Elizabeth's death did not reach some parts

of Devonshire until the Court was out of mourning, whereas the message announcing the death of Queen Victoria outstripped the sun. It has been well said that the extent of the unit of government is determined by the facility of communication, so that in the age of electricity all former notions in this respect have to be recast.

Nature may therefore be said to be still in the first chapter of Genesis in regard to social evolution. Probably with abundant provision for autonomy the social organism may eventually be found to be capable of world-wide extension, and the poet's dream of the parliament of man and the federation of the world may at some remote epoch be realised. But this far off event will not be hastened, but rather retarded, by any premature attempt to snatch attainment. A pebble dropped into a pond stirs in ever widening waves the whole surface of the water, but the extension depends on the orderly progression of each succeeding circle. There are no sudden leaps in evolution. "From lower to the higher next, not to the top is Nature's text." It is by timely limitation that the due furtherance of the process is ensured.

The evolution of empire is of intense interest to all, and is of vital importance to the British race, because it has stretched further afield and covers a greater and more diverse area than has ever been previously attempted. The idea which possessed many well disposed people at the advent of the International Exhibition epoch that the future rivalry of nations would take place in a fair field of industrial emulation, that fiscal barriers would be abolished, and that war would soon become an anachronism, must now, to say the least, be pronounced as premature. It is true that the nation, which was formerly regarded as the finished social product, has become the raw material out of which empires are constructed. The areas of government have consequently been extended, but it is only what may be regarded as division fences that have been removed. The ring fences are higher than ever. The international nexus is still of the feeblest texture, and organisation must for a long period continue to be intra- and not inter-imperial. Those are the best cosmopolitans, and best advance the destined solidarity, who pay due regard to the definite problems of the present. It is quite certain that the future will be attained by a continuance of the recognised methods of natural selection, namely, cooperation within the circle and competition without. It is well constantly to bear in mind the invariable biological rule that organisation must increase with size. Mere bulk without adequate organisation only serves to increase vulnerability. The view that the British Empire, the most extensive of all, can afford to remain less organised than any is a dangerous heresy. Not further aggregation but integration is the pressing need of the age, and the success which has in recent years attended the bringing of large areas under the federal form of government indicates that in federation will be found the best means of uniting the widely extended territories of Greater Britain. This indication is also supported by theoretical considerations, for federation affords the fullest scope for the variation and the adaptation to local conditions so indispensable to progress; while at the same time it provides sufficient integrating power to coordinate the diversified elements for defence and mutual advancement. It combines firmness with flexibility, and reconciles empire and liberty.

In the middle of last century the government of the colonies from Downing Street was found to be impracticable, and such centralisation would be doubly impossible now that both area and diversity have so greatly increased. To the preceding generation of statesmen the only alternative to the old colonial system appeared to be separation, and most assiduously they set to work to loosen the bonds and to facilitate the severance of the colonies from the Mother Country, and it was in order to pave the way to this desired dissolution that autonomy was granted. In adopting this course they were, however, all unconsciously ministering to the evolutionary requirements of a combined and not of a disintegrated empire. For at that stage the prime necessity for higher organisation was to provide free play for the variation which the diverse circumstances of the widely scattered colonies demanded. The result has been the unfettered development of nations such as Canada and Australia, which have attained an individuality of their own without any diminution, but rather with an increase, of attachment to the Mother Country. They are still daughters in their mother's house, though mistress of their own.

The requirement to-day is for sufficient integrating force to bring the diversified elements into organic union, so as to present a united front to the world and compete on equal terms with highly organised rivals. The harmonious evolution of the empire will then appear as an orderly sequence from the unity of the old colonial system, through the diversity engendered by the "beneficent neglect" and apathy of fifty years ago up to the coordination of individual but component nations in imperial federation. From the scientific standpoint the subject is fascinating, but the question that presents itself to the practical British mind is whether it is possible from a study of the mode of operation of the laws of evolution not only to comprehend the past, but to derive guidance for the future.

The withdrawal of British troops from the colonies, although at the time the step was greatly regretted, enabled the local defences, by a partial elimination of red tape, to be organised on lines better adapted to actual requirements; and we have seen with what advantage the different contingents cooperated on the veldt. Imperial countenance instead of discouragement to the development of similar individuality in naval affairs might be expected to yield equally good results. Many statesmen, both at home and in the colonies, have expressed the opinion that a mistake was made in granting fiscal autonomy to the colonies. This is probably an erroneous view; uniformity would have hindered the requisite variation. But that is no reason why, under an integrating influence, some form of coordination of tariffs might not now with advantage be effected.

In a federation many matters which are ordinarily under central control devolve upon the component States and municipalities, and thereby congestion of the central Government is avoided and autonomy is fostered. Thus the integrating influence in no way checks the working out of their own problems by the people on the spot who have the most intimate knowledge of local requirements. The time is far distant yet when a federal legislature can be established, but the sooner a permanent council of advice is erected the better for the avoidance of blunders in colonial administration. The integrating process must in no way be permitted to stunt colonial individuality and initiative; these should be treasured as the qualities which have led to the pre-eminence of the race. The refusal to crystallise into system is the characteristic of the Anglo-Saxon as compared with the Latin races, and from this capacity for variation springs the genius of the British race for successful colonisation and world-wide empire building.

JOHN A. COCKBURN.

A BOTANICAL LABORATORY IN THE DESERT.[1]

THE great impetus given to physiological and œcological botany by the foundation of research laboratories within the tropics gives some indication of the latent possibilities of the new laboratory established in the desert, where the botanical problems awaiting solution are many and varied. While numerous observations have been made upon the morphology of desert-plants, only a few detached physiological experiments have been conducted on them; yet the desert, with its sharply marked and exaggerated characters, offers a favourable field for research into manifold phases of physiological activity, and such research cannot fail to bring to light truths having a general application to plants of all climes.

Again, inquiries into the details of the geographical distribution should yield much valuable information. Of the flora of a desert tract it is known that many constituent species are descendants of outcasts from the adjoining more fertile lands, but that others belong to a few widespread orders or genera which reappear in deserts far apart, and thus show their antiquity of possession, and finally that

[1] "Desert Botanical Laboratory of the Carnegie Institution." By F. V. Coville and D. T. MacDougal. (Washington, U.S.A.: Published by the Carnegie Institution, 1903.)

still other constituents—few though they be like *Acanthosicyos horrida* and *Welwitschia mirabilis*, are

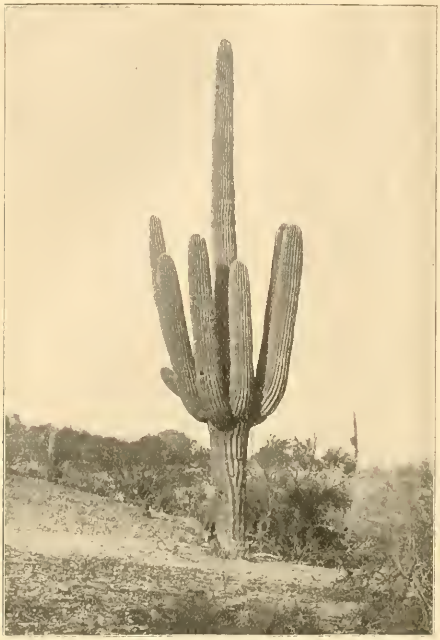


FIG. 1.—Saguaro or giant cactus (*Cereus giganteus*) near Tucson, Arizona. About 40 feet high.

enigmatic and isolated species the presence of which defies explanation. On the geographical distribution of species in deserts questions present themselves in numbers. For instance, why are certain species limited to specific areas of a large continuous desert? Competition among the component plants is practically eliminated, save, perhaps, in the seedling stage. Is the restriction of area a consequence of temperature, and therefore indirectly one of lineage, or of the chemical or physical nature of the soil, or of a number of factors? The vast North American desert district affords admirable opportunity for answering these and other questions, as it stretches, with small interruptions, from Mexico northward to the heart of the United States, and its different areas display differences in their floras. The Mexican deserts, for instance, give blurred impressions of an enfeebled tropical flora, inasmuch as they include Hæmatoxylon and Guaiacum, which are absent farther north. The Sonora desert in Mexico shows a somewhat exceptional feature in the marked presence of climbers, including malpighiaceous lianes and two other remarkable plants, a tuber-rooted straggling Cereus and the tendrilled cucurbitaceous *Ibervillea sonorae*, which in form recalls Testudinaria. Yet in this same desert there is not wanting evidence in favour of the view that climbers driven into the desert give rise to self-supporting descendants, for *Ipomoea arborescens* is a tree thirty feet in height. Another remarkable assemblage of plants is to be seen in the same desert at the harbour of Guaymas, in the salt waters of which tropical mangrove plants (Avicennia and Rhizophora) are growing side by side with typical desert plants, including two species of Cereus.

Quite apart from a desert climate, waste tracts can be induced by physiologically dry substrata, such as rocks, shifting sand, gravel, saline or alkaline soils, and these soils, or high winds, may accentuate the sterility of climatic deserts. All these conditions are to be met with within relatively easy reach of Tucson, Arizona, the site of the laboratory, as is shown by the present report, written by Messrs. F. V. Coville and D. T. MacDougal. Desert tracts occur varying from the most forbidding and bare areas with meagre floras to richer ones like that near Tucson, the desert flora of which in an eastward direction gradually gives way to the luxuriant subtropical flora of eastern Texas.

The following particulars culled from the report serve to illustrate the great variety in the deserts within reasonable distance of Tucson laboratory.

South of Tucson lies the desert of Chihuahua, "with a long stretch of sand dunes." Here the sand is siliceous, and *Yucca radiosa*, with its immensely long horizontal roots, plays a great *rôle* as a sand-binder.

The Tularosa desert, on the other hand, exhibits a remarkable area of white shifting sand, mainly composed of calcium sulphate. On these soluble "white sands" *Rhus triloba*, forming hemispherical bushes, fixes the sand, and *Populus fremontii* lives.

Lying farther north than Tucson, the Colorado desert includes gravel-hills, sand-dunes, alkali-flats, as well as wet saline and alkaline spots. Here occur unique groves of a fan-leaved palm, *Neowashingtonia filifera*, growing on alkali-encrusted soil above a moist clay subsoil. Over portions of this desert "the vegetation is subject to a veritable sand-blast," which threatens to sever the telegraph poles at a height of two feet, and has carved the creosote bushes (Covillea) into "most fantastic shapes."

The report includes a record of a few preliminary observations made by Dr. MacDougal, and a bibliography compiled by Dr. W. A. Cannon, the resident investigator. Its value and interest are enhanced by twenty-nine excellent photographs of vegetation in the deserts.

For the establishment of this laboratory botany owes a debt not only to the munificent founder, Mr. Carnegie,

FIG. 2.—Group of Palms (*Neowashingtonia filifera*) in the Colorado desert, California.

but also to the suggester of the scheme, Mr. F. V. Coville.

PERCY GROOM.

FIREBALLS VISIBLE IN THE SPRING MONTHS.

THOUGH ordinary shooting stars are rare in the second quarter of the year, fireballs appear to be moderately numerous and to afford definite evidence of some interesting systems which, like the comets of short period, move in *direct* orbits with small inclinations. Many of these systems remain uncertain, and necessarily so from the circumstances, for fireballs are usually seen accidentally, and often only by persons who are unable to record them accurately. But every year fortunately adds something to our knowledge of these interesting and brilliant visitors. They are occasionally witnessed and described by practised observers, their real paths computed, and the accumulated data now enables us to discover the special periods when fireballs are usually abundant and to determine the positions of some of their principal radiant points.

I have just completed a comparison of the dates of more than 100 fireballs (the majority of which appeared over England) seen during the last ten years in the spring quarter, and find the more prolific epochs to have been as under :—

April 1–5, 8–12, and 19–22 ; May 2–6, 11–16, 24–28 ; and June 8–10.

A discussion of many hundreds of fireballs observed before 1890, which I undertook some years ago, indicated also the dates May 31, June 6–7 and 28–30. The June 6–7 epoch nearly corresponds with the more recent one of June 8–10, the absence of leap year in 1900 and other causes having probably made the date of occurrence a little later.

Observations this year at the following epochs will be likely to add to our knowledge of these striking objects, and it is hoped they will be specially looked for during the earlier part of the night, for fireballs are more numerous during the two or three hours after sunset than at later times :—

Fireball Epoch	Notes
April 19–22.	Lyrid epoch. There will be slight moonlight.
May 2–6.	Aquarid epoch. Partial moonlight.
May 11–16.	Moon invisible.
May 24–28	Bright moonlight.
May 31.	,, ,,
June 6–7.	No moonlight in evenings.
June 8–10.	,, ,,
June 28–30.	Bright moonlight.

The fact of there being bright moonlight at several of these epochs need not interfere with observation. Fireballs are sometimes so vividly luminous as apparently "to put the moon into the shade." I have occasionally seen them flash out with astonishing brilliancy and cause shadows, though the nearly full moon was shining at the time!

In April many fine meteors diverge from Virgo and Libra, while in May there are Serpentids, Scorpiids and Ophiuchids. In June the chief radiant is in Scorpio. As a rule, fireballs move very slowly in long flights directed from radiants not far above the horizon. Whenever such objects are seen their paths amongst the stars should be carefully recorded and their durations of flight estimated.

W. F. DENNING.

SEISMOLOGICAL NOTES.

THE periodicity of the aftershocks of the great Indian earthquake of June 12, 1897, is treated by Mr. R. D. Oldham in vol. xxxv. of the *Memoirs* of the Geological Survey of India. The principal conclusions, drawn from the records of the Shillong seismograph, have already been published in the *Journal* of the Asiatic Society of Bengal, vol. xxxi., and the present paper contains particulars of the discussion of other records, of varying completeness, and shows that they confirm the conclusion already arrived at, that there is a tendency to a slight increase of frequency about the time when the horizontal tide-producing forces are varying most rapidly in amount and direction. The paper is illustrated by a number of curves of frequency, among which we may specially refer to one showing the semidiurnal frequency of shocks during the half days in which the variation of tidal stress is greatest and least; the curves are striking as they stand, but would have been even more instructive had the relative frequency been calculated to the mean of the whole year instead of to that of each period. The very marked diurnal variation in frequency is shown to have no relation to the variations of barometric pressure.

In *Die Erdbeben Warte*, Nos. 3, 4, 5, iii. Jahrg., 1903–4, Dr. A. Cancani contributes an interesting paper on the frequency of large earthquakes and small changes in latitude. What the author does is to examine critically, to extend, and to confirm results published in the seismological reports of the British Association (see report for 1900, p. 107), which show that when world-shaking earthquakes have been frequent pole displacements have been comparatively great and *vice versâ*. For example, between 1895 and 1902 inclusive, if we write the number of world-disturbing earthquakes in the position of numerators, and the corresponding pole displacements expressed in seconds of arc in the position of denominators, we get the following series :—

$$\frac{9}{0{\cdot}53} \quad \frac{18}{0{\cdot}91} \quad \frac{44 \text{ or } 47}{1{\cdot}07} \quad \frac{30}{0{\cdot}79} \quad \frac{27}{0{\cdot}72} \quad \frac{17}{0{\cdot}32} \quad \frac{22}{0{\cdot}53} \quad \frac{29}{0{\cdot}97}$$

For the first two years the earthquake records, owing to the small number of observing stations, are somewhat uncertain. The results of investigations published in the British Association report in 1903, which show that large earthquakes have also been frequent when the change in the direction of pole displacements was comparatively rapid, Dr. Cancani has apparently not had an opportunity to discuss. Two other papers in the same journal relate to the magnetic storm of October 31, 1903. In the latter of these, by Dr. A. Belar, references are made to a possible relationship between such disturbances, earthquakes, sunspots, and other phenomena.

An article on the work accomplished by Alexander von Humbolt in the domain of seismology and vulcanology, a description of the terrible shock which on January 25, 1348, destroyed Villach and shook central Europe, a register from the Laibach Observatory, and a reproduction of registers for May, 1903, which are largely those of stations cooperating with the British Association, together with reviews and notices relating to seismology, complete Dr. A. Belar's useful journal.

In No. 19 of the *Publications* of the Earthquake Commission of Vienna, Dr. E. v. Mojsisovics gives a general account of the earthquakes recorded in 1902 in the Austrian Empire, to which he adds an interesting note relating to records obtained from a pair of Wiechert's seismographs established at Pribram, one of which is on the surface and the other at a depth of 1115 m. Both pendulums from time to time show pulsatory movements, but the movements below are less than those on the surface.

In the records of earthquakes with distant origins the details of the seismograms from both instruments exactly agree, with the exception that the amplitude recorded underground is somewhat less than that recorded on the surface, which may mean that one instrument has a smaller sensibility than the other.

No. 20 contains the earthquake register from Reubeur-Ehlert pendulums at Trieste, whilst No. 21 gives similar records from Kremsmünster, both catalogues referring to 1902.

In No. 6, vol. iv., of the *Bollettino della Società sismologica Italiana*, earthquake registers are brought up to the end of June, 1902. In the latest register issued by Strassburg, which refers to June, 1903, we find the duration of the earthquakes recorded at Strassburg and the time of their commencement. In addition we find the "commencements" for teleseisms as recorded at various stations round the world, which for the most part are reproduced from the registers issued by the British Association. In the Laibach registers there are similar but more complete reproductions. The most complete reproductions, containing not only the times of commencement, but also times of certain phases of motion, duration, and amplitude, are those in the *Bollettino*. A sheet that only gives the times at which earthquakes have commenced has a value, but this would be enormously enhanced by adding other details.

CHLOROFORM ANÆSTHESIA.[1]

THE administration of chloroform is a subject that is of personal and direct interest to everyone in this present age of civilisation. Sooner or later either we ourselves or those dear to us gladly accept the relief from suffering that is offered, and that chloroform shall be given so that no unavoidable risk is run is a necessity that forces itself on our attention.

That much remains to be done in the direction of safety is only too evident. We confess to perusing the diagram of the yearly increasing death-rate from chloroform on p. 14 of Dr. Waller's lecture with a feeling of horror, and that is deepened when we read the instances given of such deaths, and supplemented by others which have come to our knowledge independently, where chloroform has been given for a trifling operation to an otherwise healthy patient, and where the phrase "Death from cardiac syncope" has acted as an anæsthetic to the conscience of the ignorant and careless anæsthetist. It is plain that some vital factor in the problem of safe chloroform administration has been overlooked, and what this consists in is readily seen when it is pointed out to us. The student of anæsthetics is taught to regard most carefully the minor details of the process; the observation of the state of the pulse and the condition of the conjunctival reflex is reduced to a fine art, but the most important detail of all, the amount of chloroform administered, is dismissed with the remark, made in our hearing by a professional anæsthetist, "I judge of the dose of chloroform by the effect[2] on the patient"!!! Yet if strychnine or arsenic were given without a measured dose, the folly of the proceeding would be manifest, and the possibility of such a remark, made by one who had spent some time in the study of the subject, shows at least that this study had been misapplied.

To replace ignorance of knowledge it is, however, necessary to do more than talk, and the lecture now under review gives an outline of the research that has been carried on in the physiological laboratory of the University of London on chloroform anæsthesia. It was apparent that there was a great lack of quantitative measurement in the process, and the first step consisted in obtaining a ready and accurate method for the estimation of the percentage of chloroform in air, and this was accomplished by the "densimetric" method. It then became possible readily to ascertain:—

(1) What percentage of chloroform in the inspired air was sufficient to cause anæsthesia.
(2) What percentage of chloroform caused death.
(3) How this death was brought about.
(4) By taking the percentage of chloroform in the *expired* air as well as in the *inspired*, together with the amount of air breathed, to measure the total quantity of chloroform used in any experiment.

Proceeding in this quantitative way, it was found that though death from too much chloroform can occur in either of two ways, yet, so far as the experiments lead us, neither way can occur when chloroform is given regularly in a percentage not greater than 2, and so before we can claim that a healthy patient has died from "idiosyncrasy" or "cardiac syncope" it is incumbent on us to show that we have not given him too much chloroform, and to ascertain that the cause of death (in at least the great majority of cases) arises from this easily remediable source, and not from some mysterious accident, is a very great advance towards safety.

We shall await the results of further observations on the human subject with interest, as well as the records of the use of the Dubois apparatus, which appears to be well adapted for clinical use. But meanwhile the facts here recorded merit the most careful consideration, and clearly point out the lines on which further research must be carried out.

[1] A Lecture on the Administration of Chloroform to Man and the Higher Animals. Delivered in the University of London on October 3, 1903, by A. D. Waller, M.D., F.R.S.

[2] By a curious mental process this anæsthetist, when the patient dies, does not consider that too much chloroform has been given, but that death has occurred from "idiosyncrasy"!

THE FIRST INTERNATIONAL CONGRESS FOR SCHOOL HYGIENE.

THAT it should be possible to hold an international congress on a subject which a few years ago had but little attention paid to it shows the enormous strides which have been made in the knowledge of the hygiene of children attending schools.

The first International Congress of School Hygiene was held at Nuremberg from April 4 to 9, and the credit for starting the congress must be given to Prof. Griesbach, the president of the "Allegemein deutschen Vereins für Schulgesundheitspflege." The energy and determination with which Prof. Griesbach overcame all obstacles are proved by the fact that every European country, except Italy and Turkey, was represented at the congress, and in addition to these European countries America and Japan were also represented.

The congress was opened formally by Prince Ludwig Ferdinand of Bavaria, and the work of the congress was carried on in sections. How extensive the work of the congress was may be gathered from the fact that there were seven sections. The first dealt with school buildings and the furnishing of the school-room, the second with the hygiene of residential schools, with the methods of hygienic investigation and research in schools, and with the physiology and psychology of educational methods and work.

The third section dealt with instruction in hygiene for teachers and scholars, the fourth with physical education and training in personal hygiene, the fifth with contagious diseases, ill-health, and conditions affecting attendance at school. The sixth section dealt with special schools, including those for the feeble-minded, the blind, deaf, dumb, cripple, invalid and exceptional children, and the seventh with out of school hygiene, holiday camps and schools, the relation of the home and the school, and the hygiene of the teaching profession.

The sectional meetings were held in the Royal Industrial School, a building well adapted for such a purpose. An exhibition of apparatus necessary for school purposes was held in the same building. Excellent arrangements had been made for the accommodation of those attending the congress, and also for obtaining information. Nor had the social side of the congress been neglected, and every facility was given to visitors to see those things in which they took the greatest interest.

Great Britain was represented by a committee with representatives from various societies interested in education and hygiene, with Sir Lauder Brunton as president.

The next International Congress of School Hygiene will be held in London in 1907, and Sir Lauder Brunton has been elected president of that congress.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

At the graduation ceremony at the University of Edinburgh on April 9 the honorary degree of LL.D. was conferred on Prof. Alexander Macalister, F.R.S.

Dr. Rose, H.M. Consul at Stuttgart, continues his account of German technical education in No. 603 of the miscellaneous series of the diplomatic and consular reports issued by the Foreign Office. The recent report is on technical schools for special branches of the metal industries. Dr. Rose finds that in Germany for certain special branches of the metal and other industries the practical instruction given to apprentices in the workshops of factories is often incomplete and not progressively arranged, and the theoretical instruction given in evening and Sunday continuation schools is generally insufficient and not even obligatory in all cases. At the special technical schools for these industries the instruction is complete and progressively arranged, practice and theory being carefully and judiciously combined. As the schools, moreover, are situated in the midst of the industries they are intended to promote, they are kept in the closest possible touch with the actual and progressive requirements of factory methods and processes. The report gives full accounts of the courses of instruction, the hours, the preliminary knowledge expected of students,

and the examinations at each of the twelve technical schools for special branches of the metal industries which have been established in Germany.

THE thirty-ninth annual catalogue of the Massachusetts Institute of Technology at Boston gives full particulars of the multitudinous courses of instruction provided and of the complete laboratory accommodation and equipment available for every branch of scientific technology. In addition to the opportunities for advanced study and investigation connected with the Graduate School of Engineering Research, the institute now offers excellent facilities for purely scientific research in all its laboratories. For research work in physical chemistry and sanitary science two new laboratories devoted exclusively to these subjects have been established during the past year. Researches in the research laboratory of physical chemistry are carried on in part by a staff of research assistants and associates and in part by graduate students working under the direction of the professors connected with the subjects of theoretical or physical chemistry A number of advanced lecture courses are offered by the members of the laboratory staff. By the generosity of an anonymous donor the institute has recently established upon land specially secured for the purpose a sanitary research laboratory and sewage experiment station, provided with facilities for demonstration of the more important methods employed on a large and a small scale for the purification of sewage and water, and in connection therewith well equipped sanitary, chemical, and bacteriological laboratories.

THE Department of Agriculture and Technical Instruction for Ireland has issued, in the miscellaneous series of its *Bulletins*, a report on some features of American education, by Mr. Robert Blair, the assistant secretary in respect of technical instruction to the department. Mr. Blair was a member of the Mosely Education Commission, and part of this report appears in the recent conjoint report of the commission. Some interesting statistics collected by Mr. Blair as to the openings for students trained in American technical institutions are summarised in the report. It appears that in the Westinghouse shops and offices 160 college-bred men are engaged, out of a total of 10,000 employees. At the Carnegie Steel Works, where there are 7000 hands, there were about 100 technically trained men, 7 of the 23 leading officers being college graduates. Of 118 engineers on the staff of the Rapid Transit Railroad Commissioners of New York City, who are constructing a city underground railway, 84 per cent. had been college students; of 75 petty officers, 58 per cent. were college trained. In the Baldwin Locomotive Works, 43; on the Pennsylvania railway lines west of Pittsburg, 52, "nearly all being graduates"; at the Schenectady works of the General Electric Co., 264; the Illinois Central Railroad Co. employ 200 men who are "either graduates of a technical institution or have had some training in that line"; and a similar proportion is true in the case of the employees of the Baltimore and Ohio Railway. Facts such as these are the best proof of the belief of the American people in higher education, and it is to be hoped that British employers of labour will soon follow a similar course. Given suitable openings for qualified technical students in this country, and the increase in the number of students in our colleges would soon be apparent.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, February 18.—"Atmospherical Radio-activity in High Latitudes." By George C. **Simpson**, B.Sc., 1851 Exhibition Scholar, Owens College, Manchester. Communicated by Arthur Schuster, F.R.S.

In 1901 Elster and Geitel discovered a radio-active gas in the earth's atmosphere, and developed a method of detecting it, also an arbitrary standard by which it can be measured. In this paper the author gives the results of a series of measurements carried out on Elster and Geitel's plan at the village of Karasjok, Lapland. The measurements were made three times a day, and continued uninterrupted for four weeks, from November 23 to December 19, 1903, during which time the sun did not rise above the horizon.

The chief result obtained is the very high value which the radio-activity attains, the mean value for the month ($A=102$) being nearly six times, and the maximum value ($A=432$) nearly seven times greater than the corresponding values found for mid-Germany by Elster and Geitel.

An analysis of the results shows that the means of the morning and afternoon observations are very near one another (87 and 88 respectively), while the mean of those for the evening is very much higher (131), thus showing a daily period.

The effect of the different meteorological elements is fully investigated, but no connection can be detected between the radio-activity and the height of the barometer or the temperature, although the latter extends over the wide range from -35° to $+2{\cdot}5^\circ$ C. On the contrary, the amount of cloud does appear to have an influence, the radio-activity for no clouds being $A=130$, for detached clouds $A=107$, for completely overcast sky $A=76$. Measurements of the potential gradient, which were made by a self-registering electrometer concurrently with those of the radio-activity, show no direct relation between the two. The aurora also appears to exert no influence on the radio-activity.

These results are of peculiar interest owing to the northerly position of the place of observation (69° 20′ N. and 25° 30′ E.), and will throw some light on the geographical distribution of atmospheric radio-activity. The hard frozen state of the ground, with its covering of snow for more than 100 miles round, are uniform conditions which should help to a proper understanding of the source of the radio-active emanation in the air.

March 10.—"On Electric Resistance Thermometry at the Temperature of Boiling Hydrogen."[1] By Prof. James **Dewar**, M.A., LL.D., F.R.S.

In his Bakerian lecture the author adverted shortly to some results obtained in low temperature resistance thermometry, and gave a table (Roy. Soc. *Proc.*, vol. lxviii. p. 363) of numerical values deduced from experimental observations for some of the more prominent metal resistance thermometers. In the present communication the experimental records of eight additional electric resistance thermometers are given, and the results of the observations on all the resistance thermometers used during the investigations are collected and compared.

Two facts seem to result from this inquiry, viz. (1) that the resistance of an unalloyed metal continually diminishes with temperature and in each case appears to approach to a definite asymptotic value below which no further lowering of the temperature seems to reduce it; and (2) that the parabolic connection between temperature and resistance is no longer tenable at very low temperatures.

Of the different thermometers constructed on the electric resistance principle, fifteen were serviceable throughout the investigations; the others broke or failed from various causes. The metals employed were platinum, gold, silver, copper, palladium, iron, nickel, and two alloys, platinum-rhodium and German silver. Every endeavour was made to attain the highest purity in the samples. In the Bakerian lecture a table (Roy. Soc. *Proc.*, vol. lxviii. p. 363) was given containing the constants of seven of these thermometers, and in the present paper similar results are tabulated for the remaining eight.

The observed resistances, after all corrections were made, were reduced both by Callendar's and by Dickson's methods, and the results are in close accord.

Platinum, gold, silver, and copper show a remarkable agreement between the two methods of reduction. In the platinum and gold groups the centigrade temperature, at which the resistance would vanish, rises with the purity. This is still seen in copper, but something of the reverse appears in the case of silver. However, the general rule is again apparent in palladium.

It is also remarkable that in the cases of all the purest metals examined, their resistances calculated by either method of reduction vanish at temperatures above -273° C. As measurers of temperature gold and silver seem to be the best metals.

As a matter of interest, one line in the table which accompanies the paper records the ratio in which the

[1] In continuation of Art. 3 of the Bakerian Lecture (Roy. Soc. *Proc.*, vol. lxviii. p. 360.)

resistance of each metal at 0° C. is reduced on cooling it to the boiling point of hydrogen. This seems to be a quantity showing no connection with other properties of metals.

While the results obtained may be considered from the point of view of metals as thermometers, yet the question of the general relation between resistance and temperature in metals is of greater importance.

The temperatures at which liquid oxygen and hydrogen boil under atmospheric pressure are known to within one- or two-tenths of a degree, namely, $-182^\circ\cdot5$ C. and $-252^\circ\cdot5$ C. Further observations made with the constant-volume hydrogen gas thermometer lead to the conclusion that hydrogen freezes about 5° below its boiling point. In the present experiments the author has been able to get eight observations in liquid hydrogen boiling under pressures varying from 5–50 mm., and the temperatures of these observations may be taken as (say) 4° below the boiling point. If the law connecting resistance with temperature be parabolic, the very gentle curvature at the boiling point of hydrogen will allow the rate of drop in resistance per degree of temperature for the 4° below the boiling point of hydrogen to be considered as roughly the same as that between the boiling points of oxygen and hydrogen (70°), so that the ratio of these two drops on this supposition should be about 4 : 70, or say one-eighteenth.

These ratios all prove to be much smaller than one-eighteenth, hence it is inferred that the curves have taken a more or less quick turn in the neighbourhood of the boiling point of hydrogen, or perhaps above it.

The observed resistances are displayed graphically in the paper, and the curves thus obtained show some instructive peculiarities. The magnetic metals present the most striking curves, being at first sight quite unlike any of the others. But closer inspection shows that this is not so, and in fact they give the clue to the general connection between resistance and temperature in metals. The curves of the other metals are all concave towards the axis of temperature, for the arcs extending from the boiling point of water, through the freezing point, down to the boiling point of oxygen; while below the boiling point of oxygen these curves are convex to this axis. On the other hand, gold and the magnetic metals are already convex to this axis from the boiling point of water to the lowest temperature reached.

It appears that in no case can anything parabolic connect resistances and temperatures ranging from the boiling point of water to that of hydrogen. The two parabolas for high and low temperatures are not only different, but also may differ from each other by any amount, within certain limits depending on the nature of the unknown curve of temperature and resistance.

Entomological Society, March 16.—Prof. E. B. Poulton, F.R.S., president, in the chair.—Mr. G. T. **Porritt** exhibited a pair of *Æschna isosceles*, taken by him with others in the Norfolk Broads last summer. The species had been regarded as almost lost to the British list for many years.—Mr. J. E. **Collin** exhibited *Phora formicarum*, Verr., which is parasitic on the ant *Lasius niger*, obtained by sweeping the herbage in a paddock at Newmarket. These flies belong to the genus Phora and to a hitherto unnamed species which has not been found or recognised by Continental dipterologists. He also exhibited Phora sp. found in a garden at Newmarket, running about at the entrance to the nest of a species of Bombus. Specimens received from Dr. Sharp, labelled "from Bombus nests," are also the same species. It is evident that its life-history is in some way connected with that of the Bombus, but because of the different shape and form of the female ovipositor, it is probably not parasitic on the bee like *P. formicarum* is on the ant, but acts as a scavenger by living on the dead pupæ in the nest.—Commander J. J. **Walker** exhibited a series of Buprestidæ from Sydney, N.S.W., comprising about 120 species, of which 70 belonged to the genus Stigmodera. Also a dried specimen of *Angophora cordifolia*, Cav., a small tree of the natural order Myrtaceæ, the flowers of which are the great attraction in New South Wales for the Buprestidæ, as well as for very many other Coleoptera; specimens of the "bugong" moth, *Agrotis spina*, Guenée, from Jervis Bay, N.S.W. (referred to at the previous meeting); and *Carthaea saturnoides*, Walk., a remarkable moth from Perth, W.A., referred to the Geometrina, but possessing an extraordinary superficial resemblance to a Saturniid.—Mr. A. J. **Chitty** exhibited a specimen of *Peribalus vernalis*, Wolff., a rare bug of which only five or six specimens appear to have been taken, and pointed out that as the records in Saunders's "Hemiptera" included Cumberland and Weston-super-Mare, and his own specimen was taken at Huntingfield, Kent, it was probably overlooked.—Dr. F. A. **Dixey** exhibited a remarkable pale form of *Mamestra brassicae*, taken by Dr. G. B. Longstaff and himself at Morthoe, North Devon, on July 16, 1903.—The president, Prof. Poulton, read some observations on the gregarious hybernation of certain Californian insects, communicated to him by Prof. Vernon L. **Kellog**, of the Leland Stanford Junior University, California. He also read a paper on the hill-top habit of some insects.—Mr. O. E. Janson contributed on behalf of Mr. F. P. **Dodd** a note upon maternal instinct in Rhynchota, and Mr. H. Rowland-Brown read a note on *Oncoptera intricata*, a moth extremely destructive to pastures in Tasmania, by Mr. F. M. **Littler**, of Launceston, Tasmania. He also exhibited examples of the imago and larva of the species, the latter closely resembling that of a Hepialid.

Chemical Society, March 16.—Prof. W. A. Tilden, F.R.S., president, in the chair.—The following papers were read:—Mercuric nitrite and its decomposition by heat: P. C. **Rây**. Mercuric nitrite, obtained by evaporating *in vacuo* the solution left by decomposing mercuric chloride with silver nitrite, occurs in groups of light yellow needles. The solid salt is largely decomposed by water. When heated it decomposes for the most part into mercurous nitrate and nitric oxide.—Note on the higher glycerides: J. B. **Hannay**. The higher glycerides, as represented by purified stearin, olive oil, linseed oil, castor oil, cotton-seed oil, rape oil, and earth-nut oil, are all capable of entering into direct combination with lead oxide, forming new compounds of wax-like consistence and character. In the case of the olein derivative, the composition may be represented by the formula $C_3H_5O_3{:}Pb_3(C_{18}H_{33}O_2)_3$, the three atoms of lead replacing six atoms of hydrogen, three in the alkyl and three in the acyl portion of the molecule.—Isomeric change of diacylanilides into acylaminoketones: transformation of the dibenzoyltoluidines into the isomeric benzoylaminomethylbenzophenones: F. D. **Chattaway** and W. H. **Lewis**.—The action of ethyl β-iodopropionate on ethyl disodioethanetetracarboxylate: O. **Silberrad**.—The heat of formation of glucinum chloride: J. H. **Pollok**. A sample of ground beryl from Limoges was employed in the preparation of pure glucina and ultimately of the metal. On dissolving the latter in hydrochloric acid it was found that the heat of formation of glucinum chloride *in solution* was 199·5 calories, whence that of *anhydrous* glucinum chloride was found to be 155 calories.—A note on the composition of distilled oil of limes and a new sesquiterpene: H. E. **Burgess** and T. H. **Page**. This oil was found to contain *l*-terpineol, an isomeric terpineol of lower boiling point, and a new sesquiterpene, limene.—The nature of a solution of iodine in aqueous potassium iodide: C. H. **Burgess** and D. L. **Chapman**. The authors confirm Jakowkin's statement that in such solutions a dissociable compound KI_3 exists.—The reduction of 2 : 6-dinitrotoluene with hydrogen sulphide: J. B. **Cohen** and J. **Marshall**. In the course of an experiment in which 2 : 6-dinitrotoluene was reduced by hydrogen sulphide in alcoholic ammonia, a quantity of 2-nitro-4-amino-*m*-cresol was obtained, together with 6-nitro-*o*-toluidine.—Acid esters of methylsuccinic acids: W. A. **Bone**, J. J. **Sudborough**, and C. H. G. **Sprankling**. An enumeration of the principal physical constants of these esters is given.—A note on phenyldimethylallylammonium compounds: A. W. **Harvey**.—Estimation of hydrogen peroxide in the presence of potassium persulphate by means of potassium permanganate: J. A. N. **Friend**. It is shown that fairly accurate estimations may be obtained if (1) the time of titration is short, (2) the volume titrated is small, and (3) the concentration of the sulphuric acid is fairly great.—A comparison of the products of the hydrolysis of potato starch with those obtained from cereal starches: J. **O'Sullivan**. It is shown that the products of the hydrolysis of potato starch by diastase bear no quantitative relationship to those yielded by the cereal starches.

Royal Microscopical Society, March 16.—Dr. D. H. Scott, F.R.S., president, in the chair.—Prof. A. E. **Wright** communicated the purport of his paper on some new methods of measuring the magnifying power of the microscope and of lenses generally. His remarks included the description of a piece of apparatus which he had invented for taking the magnifying power of the microscope and for the rapid measurement of microscopic objects. The instrument is placed over the eye-piece without disturbing any of the adjustments of the instrument, and the object on the stage can be instantaneously measured.—A short note by Mr. E. B. **Stringer** on the separation of ultra-violet light was read by the secretary.—Mr. Abraham **Flatters** exhibited on the screen a series of sixty hand painted lantern slides illustrating botanical histology.

Mineralogical Society, March 22.—Prof. H. A. Miers, F.R.S., vice-president, in the chair.—Irregularly developed crystals of zircon (specific gravity 4·0) from Ceylon: L. J. **Spencer.** The crystals were sent recently by Mr. A. K. Coomáraswámy to the British Museum for determination, and at first were thought to be rutile. They are of a dark brown colour and almost opaque; the specific gravity is 4·09, and is unaltered by heating. A section cut perpendicular to the principal axis shows interesting variations in the optical characters, successive portions being isotropic, uniaxial and biaxial; the mean refractive index is about 2·0. After being heated to redness and cooled, the material is bright green in colour, and a crystal section is now entirely biaxial, although the interference figures and birefringence vary in different parts.—Notes on "feather-ore": identity of "domingite" (="warrenite") with jamesonite: L. J. **Spencer.** "Feather-ore" is usually considered to be a variety of jamesonite, but since the latter has a good cleavage perpendicular to the length of the fibres, only brittle "feather-ore" can be included in this species; on the other hand, "feather-ore," the fibres of which are flexible, may be either stibnite, zinckenite, plumosite ($2PbS.Sb_2S_3$), boulangerite, or meneghinite. "Warrenite" is a brittle "feather-ore," and further has the same chemical formula ($3PbS.2Sb_2S_3$) as that originally given for the cleavable Cornish jamesonite.—Note on the indices of refraction of antimonite: A. **Hutchinson.** A prism, of refracting angle 8° 51′, was found sufficiently transparent to red light for the refractive indices to be determined in the usual way. The results obtained are 4·129 and 3·873 for rays vibrating parallel to the axes of Z and X respectively. Measurements of the deviation of the ultra-red rays indicate high dispersion in this region of the spectrum. The investigation is being continued.—The connection between the atom arrangements of the crystals of certain allied carbon compounds: W. **Barlow.** Using balls of the same relative size as were employed in his previous work, for instance, in models of calcite, the author forms a carboxyl slab. By uniting such slabs with balls representing barium, a structure is obtained which has the symmetry of barium formate. Again, by uniting the slabs with balls representing hydrogen, a structure with the symmetry of oxalic acid is formed. The author showed that in certain cases, in order to effect close packing, a relative shift was necessary between successive layers. He also briefly discussed the tartaric acids.—On the construction and use of the moriogram: G. F. Herbert **Smith.** The moriogram is a diagram devised by the author for the graphical determination of the angles between tautozonal poles, obeying the law of rational indices.—Note relative to the history of the Caperr meteorite: L. **Fletcher,** F.R.S.—On the meteoric irons of Bethany, Lion River, Springbok River and Great Fish River, South Africa: L. **Fletcher,** F.R.S.—Prof. J. W. **Judd,** F.R.S., exhibited two Gardette twins of quartz.

Geological Society, March 23.—Dr. J. E. Marr, F.R.S., president, in the chair.—On the Moine gneisses of the East-Central Highlands and their position in the Highland sequence: G. **Barrow.** Communicated by permission of the director of H.M. Geological Survey. The paper is divided into two parts. The first deals with the parallel-banded grey gneisses or gneissose flagstones of the Perthshire and Aberdeenshire districts, which, in their field characters as well as in their composition and structure, are identical with the Moine gneisses of the North-West Highlands. A description is given of these gneisses, as seen in and about the Garry in Perthshire, and this is followed by a brief account of the same rocks in the ground to the east and north-east, extending to the Forest of Invercauld, north of Braemar in Aberdeenshire. Special attention is directed to the fact that towards the eastern end of the area large masses of highly quartzose gneiss occur, which are really part of the Central-Highland quartzites in what the author conveniently describes as a "Moine-phase," and should not strictly be included in the typical banded grey gneisses at all. In the second part, dealing with the mode of ending off of these gneisses to the south-east, it is shown that they cease to be recognisable as Moine gneisses, owing to the fact that they thin away and also become more finely banded, while at the same time they become less crystalline or cease to be gneisses. To prove this, an account is given of a series of sections lying along a belt 40 miles in length, extending nearly from Blair Athole to the east of Balmoral, in Aberdeenshire.

Royal Astronomical Society, April 8.—Prof. H. H. Turner, F.R.S., president, in the chair.—The secretary read a paper by Mr. H. C. **Plummer** on the optical distortion of the microscopes of the Oxford machine for measuring astronomical photographs. Dr. Russell and Mr. Hinks explained the form of the microscope of the Cambridge measuring machine, and the Astronomer Royal described that which was employed at the Royal Observatory, Greenwich.—Mr. F. A. **Bellamy** read a paper, being an analysis of the results of measurements of the 1180 plates in zones +25° to +31°, allotted to the University Observatory, Oxford, in connection with the International Astrographic Chart.—Mr. Thomas **Lewis** gave an account of his memoir, measures of the double stars in Struve's "Mensuræ Micrometricæ," collected and discussed.—Prof. **Turner** read a paper on the Rousdon variable star observations. In the course of the paper was a consideration of the sun as a variable star. The evidence appeared in favour of the sun being brighter at periods of maximum activity of sun-spots than at minimum.—Sir David **Gill** spoke upon recent work at the Royal Observatory, Cape of Good Hope. He gave an account of an improved spectroscope which the observatory owed to the generosity of Mr. McClean, illustrated by photographs of the instrument and its accessories. He specially described the electrical apparatus by which the spectroscope was kept at a uniform temperature during exposure of the plates. He also showed slides from a series of photographs of the spectra of stars taken with the instrument, with comparison spectra.

Dublin.

Royal Dublin Society, March 15.—Prof. J. A. McClelland in the chair.—Prof. W. F. **Barrett,** F.R.S., read a paper in continuation of his researches, in which he has the cooperation of Mr. W. **Brown** and Mr. R. A. **Hadfield,** on the physical properties of the alloys of iron. The paper, which forms part iv. of the series, deals with (*a*) microstructure, and (*b*) thermal conductivity.—Mr. P. E. **Belas** read a paper on the structure of water-jets, and the effect of sound thereon. The paper was illustrated by photographs.—Mr. J. J. **Hutchinson** described a simple arrangement for determining the maximum pressure of vapours at different temperatures.

Paris.

Academy of Sciences, April 5.—M. Mascart in the chair.—On the pathogenic agent of human trypanosomiasis: M. A. **Laveran.** A comparative study of *Tr. gambiense* of Ford and Dutton, and *Tr. ugandense* of Castellani, showed that grown under similar conditions the two are morphologically identical. The study of the pathogenic action on various animals, the action of human serum and arsenious acid, and the fact that animals rendered immune to the one are also immune to the other, also lead to the same conclusion. The author suggests that the name *sleeping sickness,* since it represents only the terminal phases of the infection, should be abandoned, adopting the name human trypanosomiasis, as applying to all the forms of the disease.—On a necessary condition for the stability of an unlimited vitreous medium: P. **Duhem.**—Observations of the sun, made at the Lyons Observatory with the 16 cm. Brunner equatorial during the fourth quarter of 1903: J. **Guillaume.** The results are summarised in

three tables giving the sun-spots, their distribution in latitude, and the distribution of the faculæ in latitude.—On a class of multiform transcendentals: Pierre **Boutroux.**—The polaristrobometrograph, or a self-registering polarimeter: Gaston **Gaillard.** In order to follow the rate of chemical reactions accompanied by a change in the rotatory power, a combination of a Laurent polarimeter and kinematograph was designed, capable of giving from five to ten images per second, details of which are given.—On the satellite rays in the spectrum of cadmium: Ch. **Fabry.** A close examination of the cadmium ray 508·6, by the interference method previously described by the author, shows that in a tube without electrodes there are three rays, very close together, with intensities of the same order. In a tube fitted with electrodes the middle ray is very intense, the second is much enfeebled in intensity, the third being absent. The necessary condition for the clear appearance of the satellite rays is the absolute purity of the luminous gas, this condition being more easily fulfilled in tubes not fitted with electrodes.—On the structure and affinities of trypanoplasma: Louis **Léger.**—On the anomalous values of gravity in the eastern region of Etna: Gaetano **Platania.**—The geological constitution of the *massif* of Khakhadian (Soudan): H. **Arsandaux.** This part of Africa is composed of sedimentary rocks of unknown age, probably old, containing andesite tufas of volcanic origin; they are traversed by eruptive rocks of a varied nature, especially by granite.—On the origin of lactose. Urological researches during pregnancy: Ch. **Porcher** and M. **Commandeur.**—On the origin of precipitines: R. **Kraus** and C. **Levaditi.** The conclusion is drawn that the precipitines are made by the white corpuscles of the blood, the latter being probably the principal source of these anti-bodies.

DIARY OF SOCIETIES.

THURSDAY, April 14.

Royal Institution, at 5.—Dissociation: Prof. Dewar, F.R.S.

Institution of Electrical Engineers, at 8.—Direct Reading Measuring Instruments for Switchboard Use: K. Edgcumbe and F. Punga. (Continuation of discussion.)—Eddy Currents and Eddy Current Losses in Cable Sheaths: M. B. Field.

Mathematical Society, at 5.30.—On a Plane Quintic Curve: Dr. F. Morley.—Mathematical Analysis of Wave-propagation in Isotropic Space of p Dimensions: H. T. Havelock.—On Functions Generated by Linear Difference Equations of the First Order: Rev. E. W. Barnes.—Note in Addition to a Former Paper on Conditionally Convergent Multiple Series: G. H. Hardy.—Spherical Curves. Part II: H. Hilton.—Perpetuant Syzygies of Degree Four: P. W. Wood.—Transformations of the function $F([\alpha]\ [\beta]\ [\gamma]\ x)$: Rev. F. H. Jackson.—An Extension of Sylow's Theorem: Prof. G. A. Miller.—Note on a System of Linear Congruences: Rev. J. Cullen.—The Extension of Neumann's Addition Theorem for Bessel Functions: Rev. F. H. Jackson.

FRIDAY, April 15.

Royal Institution, at 9.—Korea and the Koreans: Rt. Rev. Msgr. the Count Vay de Vaya and Luskod.

Institution of Mechanical Engineers, at 8.—*Discussion*: Compound Locomotives in France: M. Edouard Sauvage.

SATURDAY, April 16.

Essex Field Club, at 6.30 (at the Essex Museum of Natural History, Stratford).—Annual Meeting.—The Natural History of Pyrites and Gypsum, the Chief Minerals of Essex: F. W. Rudler.—On the Origin of the term "Sarsen Stones": T. V. Holmes.

MONDAY, April 18.

Sociological Society, at 5.—Woman in Early Civilisation: Dr. E. Westermarck.

TUESDAY, April 19.

Royal Institution, at 5.—The Transformations of Animals: Prof. L. C. Miall, F.R.S.

Zoological Society, at 8.30.—On Mammals collected during the Uganda Boundary Commission by Mr. W. G. Doggett: Oldfield Thomas, F.R.S., and H. Schwann.—Contributions to the Anatomy of the Lacertilia. II. On some Points in the Structure of Tupinambis: F. E. Beddard, F.R.S.—On the Disposition and Morphology of the Intestinal Coils in Mammals: Dr. P. Chalmers Mitchell.—On the Characters and Affinities of the Triassic Reptile, *Telerpeton elginense*: G. A. Boulenger, F.R.S.—Descriptions of some New Species of Butterflies belonging to the family Erycinidæ from Tropical South America: H. Druce.

Society of Arts, at 8.—The Sentiment of Decoration: A. East.

Royal Statistical Society, at 5.—Five Years' Experience of the Effect of the Workmen's Compensation Acts, with Especial Reference to Schemes Certified Thereunder: W. H. Tozer.

Institution of Civil Engineers, at 8.—Aerial Suspension Cableways: J. M. Henderson.

WEDNESDAY, April 20.

Society of Arts, at 8.—Motor Cars for Popular Use: Mervyn O'Gorman.

Royal Microscopical Society, at 8.—Exhibition of Pond Life.

Entomological Society, at 8.—Nature's Protection of Insect Life, illustrated by Colour Photography: F. Enock.—*Discussion*: On Specimens of the Dipterous Families Stratiomyidæ to Cyrtidæ: G. H. Verrall, Colonel Yerbury, and others.

Royal Meteorological Society, at 7.30.—The Variation of the Population of India compared with the Variation of Rainfall in the Decennium 1891–1901: W. L. Dallas.—The Cause of Autumn Mists: J. R. Cohen.

Chemical Society, at 5.30—(1) The Vapour Density of Hydrazine Hydrate; (2) The Combining Volumes of Carbon Monoxide and Oxygen: A. Scott.—(1) Ammoniacal Double Chromates and Molybdates; (2) Double Chromates of the Series $M'_2M''(CrO_4)_2 6H_2O$ Magnesium and Nickel Compounds: S. H. C. Briggs.—Experiments on the Synthesis of the Terpenes. Part I. Synthesis of Inactive Terpineol, of Dipentene and of Terpin Hydrate: W. H. Perkin, junr.—A Lævorotatory Modification of Quercitol: F. B. Power and F. Tutin.—The Constituents of the Essential Oil of Californian Laurel: F. B. Power and F. H. Lees.—Some Derivatives of Umbellulone: F. H. Lees.

THURSDAY, April 21.

Royal Institution, at 5.—Dissociation: Prof. Dewar, F.R.S.

Linnean Society, at 8.—On British Freshwater Rhizopoda: J. Cash.—*Exhibitions*: Drawings by Mrs. C. Reid of Fruits and Seeds of British pre-Glacial and inter-Glacial Plants. II. Calycifloræ: Clement Reid, F.R.S.—Holograph Letter of Linnæus to Haller, dated from Upsala, May 12, 1747: R. Morton Middleton.

Institution of Civil Engineers, at 8.—"James Forrest" Lecture: Internal Combustion Engines: Dugald Clerk.

FRIDAY, April 22.

Royal Institution, at 9.—Sleeping Sickness in Uganda: Colonel David Bruce, F.R.S.

Physical Society, at 5.—Calculation of Colours for Colour Sensetometers and the Illumination of "Three Colour" Photographic Transparencies by Spectrum Colours: Sir W. de W. Abney, F.R.S.—On Normal Pileing as connected with Osborne Reynolds's Theory of the Universe: Prof. J. D. Everett, F.R.S.—Note on the Diffraction Theory of the Microscope as applied to the Case when the Object is in Motion: Dr. R. T. Glazebrook, F.R.S.

Institution of Civil Engineers, at 8.—No. 2 River-pier of the Beckton Gasworks: A. Trewby.

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THURSDAY, APRIL 21, 1904.

THAMES ESTUARINE FISHERIES.

Kent and Essex Sea Fisheries Committee. Report on the Sea Fisheries and Fishing Industries of the Thames Estuary. Prepared by Dr. James Murie. Ordered to be Printed at Meeting of the Kent and Essex Sea Fisheries Committee, December 7, 1903. Part i. Pp. 250. (London: Waterlow Bros. and Layton, Ltd., 1903.)

THIS report has been prepared primarily for the information of the Kent and Essex Sea Fisheries Committee by a subcommittee of that body appointed "to investigate the fisheries and recommend such steps as they may from time to time think best for their development."

The subcommittee's idea as to the scope of the report which they asked one of their members, Dr. Murie, to draw up was to select some typical fishing station and report on the conditions there, "instead of merely outlining what should be the basis of facts to be acquired at each special station." Leigh, in Essex, an important fishing centre on the north shore of the Thames Estuary, was the locality selected for the purpose, the selection being doubtless influenced by the fact that at Leigh resided Dr. Murie, who, besides being an active member of the committee, is an accomplished zoologist, and has long been in close touch with the fisheries of his neighbourhood. Dr. Murie was accordingly appointed to report on the fisheries of Leigh. He, however, found it necessary to extend the original plan of the work and to make it more general. The subcommittee was unanimously agreed as to deficiency of trustworthy information in regard to the conditions under which the various fisheries in the district are conducted. Further, as these conditions are dependent on certain biological data, it was necessary that some account of the natural history and inter-relations of the marine animals in the district should be presented. The present volume (part i. of the report) is devoted solely to the marine biology of the Thames Estuary. Information in regard to the fisheries themselves and a discussion of their economics are reserved for part ii.

Although deep-sea trawlers work from Ramsgate, Dover, &c., the main interest of the Kent and Essex district centres in the estuarine fisheries, that is to say, in the operations of shrimpers, whitebaiters, &c., and in the great shell-fish industries. In such an area the interests of one class of fishermen are sometimes at variance with those of another class. In considering the claims of one against the other, it is necessary to bring a knowledge of biology to bear on the subject; it is not enough to weigh the evidence of the fishermen themselves.

In this volume Dr. Murie gives a very readable and scientifically accurate account of the natural history of the marine animals inhabiting the Thames Estuary. This part is more than a mere fauna of the area, for the animals are considered especially in their relation to the fisheries. The geological origin of the estuary and the general physical and biological conditions obtaining therein are first described. Dr. Murie then proceeds to explain the influence of tides and winds and of North Sea currents in determining the drift of fish food and fish eggs, and hence the distribution of the fishes, concluding the section by remarking that "a paucity or abundance of fish is indissolubly linked with the less appreciable presence or otherwise of minor (often microscopic) life extant—not, therefore, as frequently emphasised, solely owing to objectionable instruments or methods of capture."

In the next section are described the rise in the fisheries of Leigh and the various changes which have taken place in methods of fishing from early times up to the present day in that locality. Then follows a large section on natural history proper, comprising all the known data which are of interest from a fisheries standpoint with respect to the various forms of animal life found in the estuary, a list which begins with porpoises and whales and ends with shrimps and prawns.

The author deals in no amateur fashion with these topics. He is thoroughly acquainted with the literature of fish and fisheries, both of early and of recent date. He has, for instance, made good use of such repositories of research as the scientific blue-books of the Scottish Fishery Board and the *Journals* of the Marine Biological Association. His own observations on the distribution, rate of growth, spawning and seasonal fluctuations of the food-fishes, molluscs, and Crustacea are of considerable value. On such matters as the location of the spawning places of the flat fishes, he seems inclined to lend too ready an ear to the opinions of fishermen, although it is not shown that the latter are capable of distinguishing with sufficient accuracy degrees of ripeness in a fish. A fish with a "full roed" ovary may be a long way in time and space from actual spawning. Even Dr. Murie himself does not seem to be very clear on this point. When he speaks of a fish the ovary of which was in the "pinky vascular stage" as being in "a moderately advanced stage," we are not satisfied with so vague a description; we require a more definite criterion of ripeness for scientific purposes.

Probably few experts will agree that the evidence which Dr. Murie adduces of spawning of flounders in brackish water is adequate. The presence in a given locality of full roed females, and later of flounder larvæ half an inch long, does not appear to prove, or even to suggest, that flounders spawn in that locality. In regard to the rate of growth of various food-fishes, the author furnishes some interesting data, but he has not dealt with these in a sufficiently detailed way to render them of much use as a contribution to the subject. He has not adopted, as other modern investigators have, Petersen's method of separating the fishes into annual groups or generations by the principle of the mid-size.

Altogether the book contains a mass of valuable and detailed information respecting the marine biology of this important estuary. Such information is an indispensable preliminary to an intelligent grasp of those practical problems to which the attention of the com-

mittee and of others interested will be directed in the second part of this report.

Dr. Murie confirms what has often been stated for other localities, viz. that the shrimpers destroy enormous quantities of the younger members of valuable species of flat fish. Whether the destruction alluded to is justified by the apparently unfailing perennial abundance of the brood fishes is doubtful. As has been pointed out by Dr. Petersen, there may be plenty of eggs and young fry of a given species, and yet the number of the larger and relatively much more valuable fishes may be seriously declining, as is maintained by many to be the case with plaice and soles. The question rather is whether the little flat fishes which escape the shrimpers in the Thames Estuary are numerous enough to replenish the stock of the larger fishes in the deeper waters off shore. In this connection local interests ought to be subordinated to those of the country in general, and therein seems to lie the danger of a too concentrated attention to purely local interests to which sea fisheries committees are naturally liable.

A STUDY OF GENIUS.

A Study of British Genius. By Havelock Ellis. Pp. xiv+300. (London: Hurst and Blackett, Ltd., 1904.) Price 7s. 6d. net.

Mr. Havelock Ellis points out that owing to the completion of the "Dictionary of National Biography" it has at last become possible to obtain a comprehensive view of the men and women who have built up English civilisation, and in order to ascertain the composition of these elements of intellectual ability which the British Islands have contributed to the world, and as a help to the study of the nature of genius generally, he has freely made use of this monumental work. The author took as a basis of eminence those to whom at least three pages are devoted in the "Dictionary," but he also included some about whom less was said if they had shown intellectual ability of a high order, and conversely he eliminated those about whom much was written if they did not possess intellectual ability. The final selection yielded 975 British men of a high degree of intellectual eminence and 55 women. These 1030 persons are discussed from various points of view, and in appendices lists are given of their names, their activities, their places of origin, the occupation of their fathers, and other data.

Apparently the counties that have contributed most largely to the making of English men of genius are Norfolk, Suffolk, Hertfordshire, Warwickshire, Worcestershire, Herefordshire, Buckinghamshire, Cornwall, Dorsetshire, Oxfordshire and Shropshire; perhaps Somerset, Devonshire, Gloucestershire, Wiltshire and Essex should be added to this list. Mr. Havelock Ellis recognises three great foci of intellectual ability in England:—(1) the East Anglian focus; (2) the south-western focus; and (3) the focus of the Welsh Border. The first of these is the most recent and the most mixed ethnologically, as East Anglia is very open to invasion, and all kinds of foreigners have settled there. The second is the largest and the oldest, and the population has much darker hair; it may be called the Goidelic-Iberian district. The district is defended by Wansdyke and Bokerley Dyke. The third is termed the Anglo-Brythonic district. The Anglo-Danish part of England—Lincolnshire, Nottinghamshire, Derbyshire, Yorkshire, and thence into Scotland—has its own peculiar anthropological characters. Its children have usually been more remarkable for force of character than for force of intellect. East Anglia is productive of great statesmen, ecclesiastics and scholars, and of musical composers and painters. It has no aptitude for abstract thinking; its special characters seem to be humanity, patience, grasp of detail, and love of liberty. The people of the south-western focus are sailors rather than scholars, and courtiers rather than statesmen; they are innovators and pioneers in the physical and intellectual worlds, and, above all, are impressive, accomplished, and irresistible personalities. The genius of the Welsh Border is artistic in the widest sense, and notably poetic; there is a tendency to literary and oratorical eloquence, frequently tinged with religious or moral emotion, and there are no scientific men of the first order. The genius of Scotland has been mainly produced by the tract between the Cheviots and the Grampians.

In science Scotland stands very high, Ireland extremely low. It is in the exact sciences that the Anglo-Dane triumphs; but the science of the district is not exclusively mathematical, and geology especially owes much to the Anglo-Dane. The East Anglian is a natural historian in the widest sense, and shows little or no mathematical aptitude. It is not easy to see anything specific or definitely Brythonic in the scientific activities of the Welsh Border; at most it may be said there is some tendency for science here to take on a technological or artistic character. The scientific characters of the south-western focus are quite clear; what we find here is the mechanical impulse, and more especially the physiological temper; inventors are numerous.

This is only one of the various subjects dealt with in this interesting book; in the chapter on heredity and parentage we find it stated that inheritance of ability is equally frequent through father and mother; genius-producing families are apt to be large, and the men of ability tend to be the offspring of predominantly boy-producing parents, and perhaps women of ability tend to belong to girl-producing parents. There is a tendency for men of ability to be either the youngest or more especially the eldest of the family. The fathers of our eminent persons have been predominantly middle-aged or even elderly, while the mothers have been at the period of greatest vigour and maturity.

Eminent persons have frequently shown marked constitutional delicacy in infancy and early life, but many developed quite exceptional physical health and vigour. The chief feature in childhood, brought out by the present data, is precocity, and this character is discussed at some length. The relation of eminence to patho-

logical conditions is duly considered, and Mr. Havelock Ellis summarises his conclusions as follows:—

"We cannot, therefore, regard genius either as a purely healthy variation occurring within normal limits, nor yet as a radically pathological condition, not even as an alternation—a sort of allotropic form of insanity. We may rather regard it as a highly sensitive and complexly developed adjustment of the nervous system along special lines, with concomitant tendency to defect along other lines. Its elaborate organisation along special lines is often built up on a basis even less highly organised than that of the average man. It is no paradox to say that the real affinity of genius is with congenital imbecility rather than with insanity."

The criticism will doubtless be made that in many cases the individuals dealt with by Mr. Ellis are too few in number to give trustworthy results; but this is a matter that was beyond his control, and no one can say that he has not made the most of available material.

TEXT-BOOKS OF PHYSICAL CHEMISTRY.

Introduction to the Study of Physical Chemistry. By Sir William Ramsay, K.C.B., F.R.S. Pp. 48. (London: Longmans, Green and Co., 1904.) Price 1s. net.

The Phase Rule and its Applications. By Alex. Findlay, M.A., Ph.D., D.Sc. Pp. lxiv + 313. (London: Longmans, Green and Co., 1904.) Price 5s.

IT will be readily admitted that there is on the part especially of our younger chemists, a growing appreciation of the methods and results of physico-chemical investigation, and the issue of a series of text-books of physical chemistry under the able supervision of Sir William Ramsay will be a welcome stimulus to the prosecution of study and research on these lines. Dr. Findlay's book on the phase rule is the first of the series, and other volumes are promised, dealing respectively with stoichiometry, relation between chemical constitution and physical properties, electrochemistry, spectroscopy, thermodynamics, chemical dynamics and reactions. The advance being made in some of these departments is much more rapid than in others, and the plan of having a volume for each branch of the subject will make frequent revision possible where there is a call for it.

Taken altogether, these volumes will be an acceptable addition to our chemical literature, for up to now the English student of physical chemistry has been dependent chiefly on translated text-books for detailed treatment of certain advanced portions of the subject. One or two of the promised volumes, it is true, will cover well trodden ground, but they are requisite in the interests of the treatise as a whole, and the editor will doubtless see that harmony and uniformity are preserved in the several parts. He has written a general introduction to the series, giving a rapid survey of the main lines along which the development of physical chemistry has proceeded, and indicating the scope of the subjects to be dealt with in the special volumes.

The mere mention of the phase rule usually strikes dismay in the heart of the non-mathematical chemist, but it may be said at once that Dr. Findlay's treatment of the subject is almost entirely descriptive. The phase rule can be formulated in a simple enough manner, and its application can be appreciated even by those who may not feel at home with Willard Gibbs. Its merit is that it has rendered possible the classification of the various kinds of equilibria on a rational and scientific basis. The parallelism between many cases of physical and chemical equilibrium becomes intelligible; the phenomena of polymorphism, as exhibited, for example, by sulphur, tin, and benzophenone, can be treated systematically, and the conditions of stability of various polymorphic forms can be definitely formulated; the equilibrium between solid and liquid in binary systems can be fully interpreted, even when the two components form mixed crystals. In the exposition of these and many other points Dr. Findlay has done excellent work, and he has succeeded in producing an interesting and comprehensive estimate of the value of the phase rule in the classification and interpretation of equilibrium phenomena.

It is a very gratifying feature of the book that it contains full and up to date references to original work, and it is to be hoped that this feature will be prominent also in the subsequent volumes. After all, the best text-book can serve only to introduce the student to the actual workers in his science, and the more of such contact the better. Dr. Findlay has very properly been liberal in the reproduction of figures, for the exposition of the phase rule would be a difficult task indeed without those graphical methods of representation that have been so characteristic of its application. Tables of numerical data, taken from original papers, are abundant, and assist materially in the realisation of the actual experimental groundwork.

As a result of the physicochemical activity of the last twenty years, and of the corresponding introduction of mathematical methods of treatment, more demands than formerly are made on the reasoning powers of the chemical student. This is probably true also in connection with the phase rule, but no one who considers the material collected by Dr. Findlay will doubt that the application of these exact methods has secured a rich harvest of coordinated knowledge.

J. C. P.

OUR BOOK SHELF.

Notes on Electric Railway Economics and Preliminary Engineering. By W. C. Gotshall. Pp. iv+251. (New York: McGraw Publishing Co., 1903.)

Engineering Preliminaries for an Interurban Electric Railway. By E. Gonzenbach. Pp. 71. (New York: McGraw Publishing Co., 1903.)

THE economic side of engineering is one which the student is generally left to pick up as best he can on his way through life. Little attention is paid to it as a rule in the course of his technical training, and it is not until he starts on practical commercial work that he begins to realise that pounds, shillings and pence enter as much into the engineer's formulæ as the fundamental units of length, mass and time. These two books should be very useful, therefore, not only to the budding electric railway engineer, but also to all students of engineering, as serving to show the many

things needed besides technical knowledge to make a good engineer.

Mr. Gotshall's work is distinctly the more ambitious of the two, in that it seeks rather to point out the general principles applicable to all cases of electric railway projection, whereas Mr. Gonzenbach confines himself to the consideration in outline of a particular case. The student will derive from Mr. Gotshall's book a good idea of the importance of every detail in the original scheme, and will see how greatly the operating costs and the dividends may be affected by careful design throughout. He will also be able to glean some useful hints on the methods of dealing with promoters, landowners, and so forth, with whom, if he is ever called upon to draw up a scheme for an electric railway, he is likely to have much to do. Many of the details and particulars in both books are naturally not applicable to this country, but this does not materially detract from their value. M. S.

The Pests and Blights of the Tea Plant. Second edition. By Sir G. Watt and H. H. Mann. Pp. xv+429. (Calcutta, 1903.)

THIS work first appeared in 1898 as a report of particular investigations on tours, but is now a large volume of more than 400 pages, with numerous illustrations. The amount of information collected is enormous, and one may understand that no tea-planter can dispense with the work, the more so since such subjects as hybridisation and the different races of tea seed, weeding, tilling and cultural operations generally, drainage and manuring of tea, pruning and plucking, &c., are fully dealt with, in addition to the enumeration and description of the multitude of insect and fungus enemies which the long suffering shrub harbours.

By means of conspicuous marginal notes the authors have undone most of the disadvantages inevitable from their general method of lumping together scraps of information derived from all kinds of sources, the relative value of which, moreover, is generally capable of being sifted because the references are given; in spite of this, however, and indispensable as the encyclopædic information is, we think much might be done in improving the style if the materials were better woven into a more narrative and continuous form. Why is it that the introductory sections on general physiology of plants—the fundamental study without which the sequel is useless are so often badly done in such works as this? Does it mean that the great schools of science have even yet not impressed their learning on the officials entrusted with such important treatises, or is it that an older generation of workers not familiar with modern researches dominates the situation?

Highways and Byways in Sussex. By E. V. Lucas. With illustrations by Frederick L. Griggs. Pp. xx+416. (London: Macmillan and Co., Ltd., 1904.) Price 6*s*.

MR. LUCAS himself aptly describes his book. He tells the reader:—"My aim has been to gather a Sussex bouquet rather than to present the facts which the more practical traveller requires," and he has succeeded in writing a delightful, chatty account of a county in which Londoners have an especial interest. The history, architecture and folk-lore, the animal and plant life of the county, and the customs and characteristics of the people are all noticed by Mr. Lucas and skilfully woven into a pleasing narrative. The illustrations, of which there are nearly eighty, are excellent, and add greatly to the charm of the book.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Learned Societies.

THERE are two other defects of the present system of reporting on papers to which I desire to direct attention. In the first place there are certain mathematicians who resemble the Athenians in the time of St. Paul, who "spent their time in nothing else, but either to tell, or to hear some new thing." They are consequently averse to reporting in favour of a paper unless it contains new results. Against this excessive craving after novelty I emphatically protest. Many interesting results frequently drop out incidentally in the course of a long and complicated investigation, whilst others have been originally obtained by some cumbrous, troublesome and antiquated process,[1] and in my judgment a paper which supplies concise, simplified and improved demonstrations of results of this character is quite as valuable as one which is devoted to the investigation of new results.

In the next place, as a general rule, none of the councillors present have read the paper unless any of them happen to be referees. Moreover, a good many of the councillors present, even if they had tried to understand the paper, would be quite incapable of expressing an opinion as to its merits, and I well recollect that I myself have sometimes experienced considerable embarrassment when invited to vote officially as a councillor against the publication of a paper which lay outside my own line of reading, and I have sometimes got over the difficulty by abstaining from voting.[2]

I regard Prof. Bryan's suggestions as altogether impracticable. In the first place no person possessing ordinary common sense would run the risk of adverse criticism by consenting to report on a paper relating to a subject with which he was only slightly acquainted. In the next place no author, except a very junior one, would consent to subject his papers to the extensive revision, which Prof. Bryan appears to contemplate, at the suggestion of an *unknown* and possibly a very junior referee. He would probably regard such suggestions as a piece of impertinence (and I recollect one such case in connection with a foreign mathematician), and he would make short work of them by insisting on the society printing his paper as it stands or returning the manuscript for publication elsewhere.

I believe that every Royal Academician possesses the privilege of hanging a certain number of his pictures every year, and I see no reason why a similar privilege should not be extended to members of learned societies with regard to the publication of their papers. A. B. BASSET.

Fledborough Hall, April 16.

Department of International Research in Terrestrial Magnetism of the Carnegie Institution.

THE trustees of the Carnegie Institution at their annual meeting last December authorised the establishment of what is to be known as the "Department of International Research in Terrestrial Magnetism." An allotment of twenty thousand dollars was made with the expectation that if the proposed work should be successfully organised, a similar sum would be granted annually for the period requisite to carry out the plan submitted by the writer, as endorsed by leading investigators, and published in "Year-book" No. 2 of the Carnegie Institution.

The undersigned has been appointed director of the department, and has been given full authority to organise it, beginning with April 1. Arrangements have also been made so that the magnetic survey and magnetic observatories of the United States, conducted under the Coast and Geodetic Survey, will remain in his charge as heretofore.

[1] The method by which Euler's equations for the rotation of a rigid body used to be proved is an example.

[2] A very glaring example of the imperfections of the present system will be found in the *Phil. Trans.*, A. 1892, in connection with Mr. J. J. Waterston's paper.

The general aim of the work is "to investigate such problems of world-wide interest as relate to the magnetic and electric condition of the earth and its atmosphere, not specifically the subject of inquiry of any one country, but of international concern and benefit." The prime purpose, therefore, of this department is not to *supplant* any existing organisation, but rather to *supplement*, in the most effective manner possible, the work now being done, and to enter only upon such investigations as lie beyond the powers and scope of the countries and persons actively interested in terrestrial magnetism and atmospheric electricity.

At first principal stress will be laid upon the complete reduction, discussion and correlation of the existing observational data, and upon early publication of the results in suitable form, in order to exhibit the present state of our knowledge. In this way will be revealed the gaps to be filled, and the direction of future and supplementary investigations will be suggested. While, however, this will constitute at first the chief work of the department, it is likewise proposed to embrace favourable opportunities for supplementing, by observation, the existing data and to cooperate with others in the observing of such of the earth's magnetic and electric phenomena as are of momentary occurrence, and the investigation of which is of great importance.

Details as to the method of work to be followed by the department and the investigations undertaken will be made known later. It is proposed that, whenever feasible, those having certain pieces of work already in hand shall be invited to associate themselves with the department.

A word of explanation as to the "international" character of the undertaking. As all the funds are supplied by the Carnegie Institution, it will not be possible to organise this department in accordance with the customs governing organisations the funds of which are contributed by various nations in concert, such as, for example, the International Geodetic Association, the "International Catalogue of Scientific Literature," &c. While, however, the basis of organisation cannot be "international" in the sense usually defined by such bodies, it is the intention to conduct the work with the counsel of an advisory board composed of representative persons, irrespective of country. The work itself, as already stated, is not confined to any one country, and in this sense the department is to be truly "international."

That an important step has been taken by the Carnegie Institution will be patent to all who are interested in the development of our knowledge of the earth's magnetism and electricity. Prof. Neumayer, one of the representative investigators who endorsed the undertaking and promised support, expressed himself thus when this project was submitted to the Carnegie Institution:—

"I am of opinion that if this plan reaches its fulfilment it is the most important step ever taken for the development of our knowledge of the earth's magnetism. The thought which underlies it must appeal to everyone who has ever been engaged in geomagnetic investigations. In no other branch of geophysics is it more essential to extend the inquiries over the entire earth. Magnetic research, to be successful, requires the cooperation of the most competent investigators of all countries."

All communications intended for the department should be addressed as below. L. A. Bauer.

Department of Terrestrial Magnetism, Carnegie Institution, Washington, D.C.

The Formation of Coral Reefs.

In Nature for February 18 there is a paper by Mr. J. S. Gardiner giving a concise account of his theory of coral reefs. A more extended paper by him on the same subject appeared in the *Geographical Journal* for 1902, and was followed last year by one by Mr. Günther on erosion on the west coast of Italy; the latter author proves, on a coast with a very strong sand scour and with loose calcareous rocks on the fore-shore, that below "wind and water" mark no erosion to any appreciable extent goes on. Mr. Günther's observations coincide with those of every day experience, and should no one have already protested against Mr. Gardiner's views, will you let me record my most vigorous dissent? The principles of geology are so little understood, and it requires such a level head in sorting out the true from the false from among the apparently conflicting evidences that one has to deal with, that I think when such a glaring misconception of the processes of nature as that of Mr. Gardiner's is repeated in scientific journals some stand should be made before more mischief is done. It is a disadvantage on my part not to have worked on coral reefs myself, but I have been working for ten years on a coast which is fringed with coral reefs only a short way from where I have seen it, and I have therefore been able to study the base of the reefs without the disguising covering of coral limestone. I have seen beaches crowded with the shells of animals still living in the adjoining sea, raised two and three hundred feet above sea-level, and a short distance away I have seen consolidated sand-dunes going far below sea-level; while from the submerged plateau the edge of which is called the Agulhas Bank, Dr. Gilchrist has dredged large water-worn boulders far out to sea. South Africa generally is a rising area, but in a sinking area the exact converse is true, namely, that with a general sinking local elevations must occur. This last is not a new statement of fact, but a well established experience, and one that has been treated of again and again, for instance, by Suess, in his "Antlitz der Erde," vol. ii. chapter i., and is one which I believe can be proved on any coast—it is well brought out in Mr. Günther's paper, and in many descriptions of coral islands; with such a statement before one, I am at a loss to understand where the room comes in for Mr. Gardiner's theory, or where are the difficulties which led to the manufacture of the hypotheses of Messrs. Murray and Agassiz. The one fundamental idea that dominates the whole conception of the earth's structure is that the crust is never at rest, but is incessantly rising and falling; and a corollary is that each great rise or fall is never continuous, but is the result of the surplus of a series of + and − movements. If we are to adopt Mr. Gardiner's view that submarine erosion can cut down solid rock to 200 fathoms below the surface of the water, geology must be deposed from its pedestal as a science, and relegated to the class which includes gnostic theology and such like. Ernest H. L. Schwarz.

South African Museum, Cape Town, March 9.

Mr. Schwarz, as far as I understand him, questions the effects, if any, of submarine erosion and the necessity for any view except that of subsidence to explain the formation of coral reefs. I fail to see the parallel between the west coast of Italy and the Maldives, but it is obvious that wherever submarine currents exist there must be erosion, its extent depending on their force, &c. I would refer Mr. Schwarz to the detailed work on currents and the effects of organisms in my full paper on the Maldive and Laccadive Archipelagoes in the "Fauna and Geography of the Maldives and Laccadives." He will find there certain references, but in the same connection he should read Prof. Agassiz's numerous papers issued from the Museum of Comparative Zoology at Harvard, and Prof. Max Weber's and Captain Tydeman's reports on the Siboga Expedition.

In common with most recent workers on the subject I have treated of my difficulties in respect to the acceptance of the subsidence theory in the paper already cited and in my report on Fiji, and Mr. Schwarz will pardon me if I do not feel disposed to re-state them. The gentlemen he refers to have probably stated theirs. We are doubtless well aware of the general facts mentioned by Mr. Schwarz, and I feel sure that we shall be only too happy if he will explain our difficulties and assist us in arriving at *the truth* on this important question.

I may take this opportunity of pointing out that, according to the report of the Coral Reef Committee, Funafuti has probably been largely formed by subsidence, and hence may be an example of the fourth mode of formation mentioned in my article. J. Stanley Gardiner.

Zoological Laboratory, Cambridge, March 31.

Demonstration of Magnetostriction.

In a recent number of Nature (March 24) Prof. H. Nagaoka describes a method for demonstrating the change of length of an iron wire by magnetisation. I have for

several years used the following arrangement for this purpose.

A small weight is suspended by an iron wire constituting a torsion pendulum. Direct current is sent through this suspending wire and through a magnetising coil which surrounds it. This direct current is reversed in the magnetising coil (or in the suspending wire) in rhythm with the free oscillations of the pendulum. This causes the outside portions of the suspending wire to be magnetised successively along right and left helical lines, and the accompanying changes of length along the lines of magnetisation cause the wire to twist slightly to right and to left with the reversals of current. After several reversals of current the oscillations of the torsion pendulum become easily perceptible. W. S. Franklin.

Physical Laboratory, Lehigh University, South Bethlehem, Pa., April 6.

Wawo and Palolo Worms.

In your interesting note on the palolo worm of Samoa (Nature, March 31, p. 523) an error has crept in about the *wawo* of Rumphius, which is said to be doubtless the same as the Pacific palolo. Thanks to the kindness of Prof. Max Weber, the head of the Dutch Siboga Expedition, that explored the seas of the Malay Archipelago during the years 1899–1900, I had the opportunity of examining a cluster of these worms from Banda, where they are called *oelie* by the natives; especially in the months of March and April, the second and third nights after full moon they are swarming there in great numbers at the surface of the sea.

In the "Rumphius-gedenkboek," consecrated to the memory of the eminent naturalist of Amboyna, who died two hundred years before, which was edited by the Koloniaal Museum at Haarlem in 1902, I published a short description and some figures of this interesting worm. Though, like the Pacific palolo, a member of the family of Eunicidæ, the *wawo* or *oelie* belongs to the genus Lysidice, and is a rather small worm, measuring about 65 millimetres in length. Nearly all the specimens were in a state of sexual maturity, their bodies crammed with sperm or ova, but without showing any epitokal characters; the number of males and females appears to be nearly equal. In our preserved specimens nearly all the colour has vanished, but during lifetime males and females undoubtedly are differently coloured, probably green and red, as stated by Mr. van Hasselt, the assistant-resident, who collected the worms. R. Horst.

Museum of Natural History, Leyden.

[The writer of the notice merely followed the original author, Mr. Woodworth, in identifying the "wawo" with the palolo. On referring again to Mr. Woodworth's article, he finds the mode of expression somewhat ambiguous, so that it might possibly bear another interpretation.—Editor.]

The Base of Napier's Logarithms.

In your issue of March 3 (p. 409) I read:—"The base of Burgi's logarithms is nearly e, and that of Napier's nearly e^{-1}." In the "Encyklopädie der Elementaren Algebra und Analysis," by Heinrich Weber, Leipzig, 1903, p. 108, I read:—"Die Basis der Neperschen Logarithmen stimmt also sehr nahe mit der Zahl e überein."

Can your reviewer kindly explain on which side lies the truth? Adolfo Bossetti.

Turin, Italy.

What Napier actually gives in his table is a series of natural sines with a corresponding series of logarithms which diminish as the sines increase. If a Napierian logarithm is considered to be the logarithm of the sine opposite to which it stands, the base is approximately e^{-1}; but we may, if we like, regard the logarithms as logarithms of cosecants, and the base is then approximately e. Or again (as in "Encycl. Brit.," xvii., 179) we may take Napier's sines as actual integers, and use log Nap n for the logarithm placed opposite n in the table; then we have approximately

$$\log \text{Nap}\ n = 10^7 \log_e (10^7/n).$$

Thus opposite 5000000, which is entered as the sine of 30° to radius 10^7, we have a logarithm which, read as an integer, is approximately $10^7 \log_e 2$. Inspection of Napier's table gives more information than any brief description can do; as will be seen from what has been said, the definition of a Napierian logarithm and of its base depends to some extent upon how we translate his phraseology into modern notation. G. B. M.

BORINGS INTO A CORAL REEF.[1]

The work before us consists of a series of reports by different authors in connection with the three expeditions that were sent to Funafuti in 1896, 1897 and 1898. Their object was to obtain by boring a vertical core of at least 100 fathoms from the rock of a typical atoll, to settle, if possible, the vexed question of its formation. Naturally the different parts of the work are of unequal value. Indeed, all must be regarded as of quite subsidiary importance to that on the core, and are of interest mainly in so far as they throw light on its composition.

Little modern scientific work shows a better record of determination and thoroughness than this. The first expedition under Prof. Sollas was a failure, but the experience gained in its two borings of 105 and 72 feet made possible the subsequent success of the later expeditions, and the reports of its members threw a flood of light on the atoll itself, its fauna and flora. The most valuable direct result was the production of a chart giving a more thorough and detailed survey of an atoll than had ever before been attempted. The great care exercised by Captain Field and the officers of H.M.S. *Penguin* in this work has made feasible, by a re-survey of the atoll in a few decades, a comparison to show the changes that are at present in progress. To it we owe the possibility of the detailed geological survey of the atoll by Prof. David and Mr. Sweet (Section v.), which will be of material assistance for the same purpose. The magnetic survey, too, worked out by Captain Creak (Section iii.), by pointing out in the areas of greatest disturbance the probable positions where magnetic rocks might nearest approach the surface, suggested the idea of driving a boring down through the bottom of the lagoon, subsequently brilliantly carried out by Mr. Halligan with the aid of the captain and officers of H.M.S. *Porpoise* (Section vii.), Fig. 1.

The second expedition carried the bore to 698 feet, but was unsatisfactory in view of the small amount of core obtained. It, however, completed the geological survey of the islets. Finally, the third expedition drove the same boring beyond 1100 feet, the greater part of its core being almost continuous, and put down a second in the lagoon to a depth of 245 feet from the surface. Collections were also made from the outer slopes to 200 fathoms, and the biology of the atoll was studied by Mr. Finckh (Section vi.).

The latter section is, perhaps, the least satisfactory part of the whole report, mainly because the examination of the core suggests so many questions to which no answer is given. Its most interesting observations are those on the rates of growth of various organisms, a mass of Halimeda three inches in height and thickness in six weeks being quite remarkable. Attention is directed to the barrenness of the eastern or windward reef as compared with the western or leeward reef. No explanation beyond that of an "epidemic" is afforded, though whether any is necessary beyond the known effects of sediment on coralline life and the undercurrents on exposed reefs, both far more important to windward, is doubtful. The section gives

[1] "The Atoll of Funafuti." Being the Report of the Coral Reef Committee of the Royal Society. Pp. xiv+428; illustrated, and with 19 geological maps. (Published by the Royal Society.)

the idea that the Funafuti reefs are now very different from what they were when the core was being formed. Practically Lithothamnion, Halimeda, Heliopora, Millepora, Porites, Madrepora and Pocillopora are stated to be the only sedentary organisms of importance at the present day, the section being little more than an essay on them. We look in vain for precise accounts of upgrowing shoals more than two or three fathoms deep, of the silting up of the lagoon, and of the outward extension of its encircling reefs. Does the boring alga Cliona occur in the living reef corals, and do boring worms affect them?

The detailed account of the collections from the outer slope is not included in the present report, a matter of regret when one considers their importance in connection with the depth of formation of the core and with certain theories of coral reef construction. As it but the dredgings were evidently too few—the naturalists had only an open row boat—for deductions to be drawn as to the occurrence of individual species and genera.

The main part of the work, that on the boring, appropriately commences with a general introduction by Prof. Judd, in whose hands its supervision was placed. From the main hole, $1114\frac{1}{2}$ feet, about 384 feet of core was obtained. It was carefully labelled, and boxes of sand collected at intervals to fill up its gaps. From the middle of each piece of rock a slice was taken longitudinally, the total length of these being the total length of the core. These slices were then examined, and from all portions which presented difficulty microscopic sections were ground. The corals of much of the core being in the form of casts, a set of wax impressions of recent forms was made for

FIG. 1.—The Lagoon Boring Apparatus on H.M.S. *Porpoise.*

is, the general report on them forms one of the most interesting sections of the volume, and it is greatly to be hoped that the specimens will subsequently be deposited with the core. The face of the cliff, 40 to 140 fathoms, is apparently composed mainly of the remains of the same organisms as form the shelf above, while the area at its base, from 140 to 200 fathoms, is covered by a talus of the same. A few true corals and some Halimeda (one piece 86 fathoms) were obtained below 40 fathoms, but this depth is considered to be about their true limit. Lithothamnion and Polytrema grew in abundance from the surface to 200 fathoms, while Cycloclypeus, a foraminiferan sparingly present in the core between 570 and 1070 feet, was found from 30 to 200 fathoms. In addition some deep-sea corals and other organisms were secured, comparison. Prof. Judd personally contributes a most valuable article on the chemical composition of the core (Section xiii.), while to Dr. Hinde we owe its detailed examination and the elucidation of the nature of its organisms, with the exception of the Foraminifera, assigned to Mr. Chapman (Section xi.). Lastly, Dr. Cullis gives a full report on its mineralogical changes (Section xiv.).

From the surface to a depth of 748 feet only $72\frac{3}{4}$ feet of core were brought up. The first 150 feet gave 26 feet, consisting mainly of corals and the regular reef organisms very little changed in any way. Deeper the aragonite of the corals was found to have been gradually dissolved, other organisms of more resistant structure persisting, until at about 400 feet such core as there is consists of cavernous limestone, formed

largely of Foraminifera with casts of corals, the whole cemented together by crystalline calcite. Foraminifera predominate still more between 637 and 748 feet, where the rock becomes soft and chalky looking, crystalline dolomite largely replacing calcite as the cementing material. From this depth to the bottom, 366½ feet, the core was 311½ feet long, the rock being a hard dolomitic limestone, with frequent cavities where organisms had been dissolved out. Corals are only represented by casts, and these are generally very badly preserved, though in some places protected by incrustations of Polytrema or Lithothamnion. Here and there occurs a disposition to form alternate bands of corals and Foraminifera mixed with detritus, the thickness of the latter considerably exceeding that of the former.

The whole core was divided into 1065 lengths, each of which has been separately examined and described which the various expeditions were sent out to solve. Their matured judgment, after examining the whole core, could not but have been of great value. It is quite clear, however, that they consider the whole core, running through nearly 200 fathoms, to consist of the same materials and to have been formed in the same way. Lithothamnion, Polytrema, and certain Foraminifera extend through the whole of it, but also live down to 200 fathoms. Unfortunately our knowledge of the bathymetrical limits of corals is less certain, but, so far as it at present goes, they cannot have grown at a greater depth than 50 fathoms. The characteristic sedentary organisms of 50 to 200 fathoms are stated to be absent from the core, and, if this be the case, it seems almost certain that Funafuti in its upper 200 fathoms owes its formation to some change or changes of level in the sea floor.

Had there been such a subsidence practically *all*

Fig. 2.—Ocean Side of Funafuti Island, from the living Lithothamnion Reef to the Hurricane Beach, opposite the Site of the main Boring.

by Dr. Hinde. The core from the borings of the first expedition was similarly treated, as was also that from the lagoon boring, though the latter was largely fragmentary in its nature. It was situated about one and a half miles from the middle of the eastern rim of the lagoon, and commenced at a depth of 101 feet. Two borings were made, the deeper reaching a depth of 144 feet below the floor of the lagoon. To a depth of 70 feet an uncemented material was obtained consisting mainly of Halimeda fronds and a few Foraminifera. Below, this was gradually replaced by a porous, rubbly limestone formed of the same genera of corals as now live in the lagoon, together with Foraminifera, the whole cemented by calcite into a hard rock.

In our opinion it is unfortunate that Prof. Judd and Dr. Hinde have not clearly expressed their opinions on the formation of the atoll, really the sole question the corals of the core should be in their positions of growth. Corals are frequently stated in the report to be so, but the question as to whether they are or are not is such an important one that the full evidence should have been given. Coral colonies differ largely in different parts of their surfaces, but that any conclusions could be drawn from casts as to their positions of growth seems doubtful. Again, the relatively small size of the corals found in the core—five or six or more corals per foot—does not agree with the usual descriptions that have been given of coral growth *in situ*, and seems better explained by the consolidation of a heap of dead corals. If the rock were formed by a growing reef in shallow water it should be observed that no reef similar in its constitution was found by Mr. Finckh. However, the authors evidently consider that they have proved a vertical thickness of nearly

200 fathoms of rock not showing organisms other than live in the upper 50 fathoms, and in that case the conclusion can hardly be avoided that subsidence has taken place.

The analysis of the core rock shows that down to about 640 feet it is a limestone, between 10 and 35 feet containing more than 10 per cent. of magnesium carbonate with two maxima of about 16 per cent., but below this averaging about 4 per cent. Still deeper it becomes dolomitic, containing upwards of 40 per cent of magnesium carbonate, but in one area, 820 to 870 feet, averaging less than 15 per cent., with further falls at 1061 and 1080 feet. The presence of 4 to 5 per cent. of magnesium carbonate is explained by the leaching out (solution) of the more soluble calcium carbonate, while the magnesium carbonate is left to enrich the rock. This factor will not serve to explain either the large amount near the surface or the enormous increases at certain depths, but the reader should carefully consider for himself Prof. Judd's discussion of the chemical changes.

Considered in its entirety, the work has been well and carefully done. It adds immensely to our knowledge of the possible means of the formation of coral reefs, and shows that subsidence may have at any rate played a dominant part in the formation of Funafuti. The illustrations are well chosen and all that could be desired. The geology is illustrated by an admirable series of maps. Indeed, the work reflects immense credit on all who have been connected with it, and cannot but be of great permanent value.

THE FORTHCOMING CAMBRIDGE MEETING OF THE BRITISH ASSOCIATION.

THE fourth meeting of the British Association at Cambridge will be held this year from August 17 to August 24. In 1833, the third year of its existence, the association met at Cambridge under the presidency of Prof. Adam Sedgwick; Sir J. F. W. Herschel presided over the second meeting in 1845, and the third Cambridge meeting was held in 1862 under the presidency of Prof. Willis.

The arrangements are already sufficiently advanced to admit of a preliminary forecast of the programme of the meeting next August. The invitation to the association to visit Cambridge in 1904 was presented by the university and the town, and by the county councils of Cambridgeshire and the Isle of Ely, and these bodies are all represented on the various committees entrusted with the local arrangements. The Mayor and Corporation have kindly consented to the use of the Guildhall for the purposes of a reception room; the Corn Exchange will be utilised for the president's address on August 17, and the lectures will be given in the new theatre.

The sectional meetings will in most cases be held in the buildings of the several science departments. The sections are the following:—A, mathematical and physical science, president, Prof. Horace Lamb, F.R.S.; B, chemistry, president, Prof. Sydney Young, F.R.S.; C, geology, president, Mr. Aubrey Strahan, F.R.S.; D, Zoology, president, Mr. William Bateson, F.R.S.; E, geography, president, Mr. Douglas W. Freshfield; F, economic science and statistics, president, Prof. William Smart; G, engineering, president, Hon. Charles A. Parsons, F.R.S.; H, anthropology, president, Mr. Henry Balfour; I, physiology, president, Prof. C. S. Sherrington, F.R.S.; K, botany, president, Mr. Francis Darwin, F.R.S.; L, educational science, president, the Right Rev. the Lord Bishop of Hereford.

A "Handbook to the Natural History of Cambridgeshire," specially written for the meeting under the editorship of Dr. J. E. Marr and Mr. A. E. Shipley, will be published by the University Press; the syndics of the Press have decided to present a copy to each ticket-holder, provided that the number to be supplied for the purpose does not exceed 2000 copies. A special edition of Mr. J. W. Clark's "Guide to the Town and University" will be presented to each member of the association, also a series of excursion guides, together with a coloured map of East Anglia supplied by the Director-General of the Ordnance Surveys.

Emmanuel College has agreed to entertain the secretaries of sections. The majority of the colleges have expressed their willingness to entertain free of charge a limited number of distinguished guests, and some of the colleges have agreed to place rooms at the disposal of members of the association, making a charge for meals and attendance. Girton and Newnham Colleges, and the Ladies' Training College, have also agreed to extend hospitality and lodging accommodation to British and foreign visitors.

A considerable number of favourable replies have been received in answer to invitations issued to American and foreign men of science; it is expected that at least 100 visitors from abroad will be present.

The master and fellows of Trinity College have kindly granted the use of the college for a conversazione and reception to be held on Thursday, August 18. The Lord-Lieutenant of Cambridgeshire and the Mayor of Cambridge will entertain the members and associates at a garden-party in the Botanic Garden on Monday, August 22. The High Sheriff of Cambridgeshire has also expressed his intention of giving a garden-party during the meeting.

It is hoped that a *table d'hôte* lunch will be served on week-days in certain college halls. Light refreshments will be served each day (including Sunday) in the Masonic Hall, adjoining the museums and close to the reception room, from 12 to 8 p.m. It has also been arranged to have an open-air café and beer-garden on ground adjoining the museums, which will be open on week-days from 11 to 6.

The committee has provisionally arranged eleven excursions for Saturday, August 20. These include Audley End and Saffron Walden, Brandon and Didlington Hall (flint-knapping industry and Lord Amherst's collection of Egyptian antiquities), Cromer (geological), the Dykes of Cambridgeshire; Ely, Hatfield and St. Albans, Lincoln, Lynn, Castle Rising and Sandringham, Norwich, Wicken Fen, Wisbech and Woad Works.

On Thursday afternoon, August 18, the registrary of the university, Mr. J. Willis Clark, will deliver a lecture on "The Origin and Growth of the University." The evening lecture on Friday, August 19, will be on "Ripple-marks and Sand-dunes," by Prof. George Darwin, and on Monday, August 22, the second evening lecture will be delivered by Prof. Osborne, of New York, who will give an account of "Recent Explorations and Researches on Extinct Mammalia." On Saturday, August 20, Dr. J. E. Marr will lecture to the operative classes on "The Forms of Mountains."

On Friday, August 19, a garden-party will be given by the principal of Girton College, and on Tuesday afternoon, August 23, members of the association will be entertained at Newnham College.

A classified list of lodgings and hotel accommodation is now being prepared for the use of intending visitors. Information in regard to lodgings may be obtained from Mr. A. Hutchinson, Pembroke College. General inquiries should be addressed either to the local secretaries, British Association, or to Mr. A. C. Seward, Emmanuel College, Cambridge.

NOTES.

WE notice with deep regret that Sir Clement Le Neve Foster, F.R.S., professor of mining in the Royal College of Science, died in London on Tuesday, at sixty-three years of age.

THE Faraday lecture of the Chemical Society was delivered at the Royal Institution on Tuesday by Prof. W. Ostwald, his subject being "Elements and Compounds." At the end of the lecture, Prof. Tilden, who occupied the chair as president of the society, presented Prof. Ostwald with a medal bearing the image of Faraday, which had been specially struck in commemoration of the occasion. A vote of thanks for the lecture was proposed by Prof. Dewar, seconded by Prof. Thorpe, and supported by Lord Rayleigh.

MR. FRANCIS GALTON is about to address a circular letter and a schedule of questions to each fellow of the Royal Society on "Ability in Families." He asks for a return of those relatives in specified near degrees who have achieved any kind of "noteworthy" success. This is defined to be a success in any pursuit whatever that ranks among those who follow that pursuit at least as high as success in gaining the title of F.R.S. ranks among men of science. Nothing is desired that is otherwise than honourable to members of the family, and nothing that has not already appeared in print, though it would be very difficult, if not impossible, for a stranger to hunt it all out for himself. This new form of hereditary inquiry is expected to be fruitful of results, and will probably be extended in other directions after the experience of the present attempt.

THE death is announced of Dr. A. P. Aitken, professor of chemistry and toxicology in the Royal (Dick) Veterinary College, Edinburgh, since 1875.

MR. PERCY LONGMUIR, of University College, Sheffield, has been appointed junior assistant in the metallurgical department of the National Physical Laboratory. Mr. Longmuir is a pupil of Prof. Arnold, and has for two years been engaged in research as a Carnegie scholar of the Iron and Steel Institute. He will at present assist Dr. Carpenter in carrying on the work undertaken by the laboratory for the Alloys Research Committee of the Institution of Mechanical Engineers.

As the searches hitherto made for Baron Toll's polar expedition have been in vain, a reward of 5000 roubles (500*l.*) is offered by the Academy of Sciences at St. Petersburg for finding the whole expedition party, or any part of it, and a reward of 2500 roubles (250*l.*) for giving the first exact indications of tracing the party. The expedition, which was sent out by the Academy of Sciences, left the Bennett Island, lying north of New Siberia, on October 26 (November 8), 1902, taking a southern direction. It has been suggested that the expedition may have drifted towards Franz Josef Land, and it is therefore desired to direct the special attention of whalers to this notice.

THE Weights and Measures Bill, designed to secure greater uniformity in the administration of the law relating to weights and measures, was read a second time in the House of Commons on April 15. In moving the second reading, Mr. Bousfield explained the provisions of the Bill, and pointed out that the fourth section of the Bill had reference to the metric system. It was proposed that after January 1, 1908, the two abnormal systems of troy weight and apothecaries' weight should be abolished in favour of the metric system. This would produce no disorganisation of trade, and would be an instalment of the reform desired, which, although a measure was now before the other House, it was unlikely that any Government would make *en bloc*, as it would at first result in unpopularity. In the subsequent debate many objections were raised to this section of the Bill, and it was on the understanding that the section referring to the metric system was to be withdrawn that the Bill was read a second time.

WE regret to see the announcement of the death of Sir Henry Thompson, distinguished as a surgeon and by his active interest in many departments of science. Sir Henry Thompson was born at Framlingham, Suffolk, on August 6, 1820, and received his early education at University College, London. He gained the Jacksonian prize of the Royal College of Surgeons in 1852 and 1860 for essays on surgical subjects. In 1866 he was appointed professor of clinical surgery in University College Hospital; and in 1884 he became professor of pathology and surgery to the Royal College of Surgeons. He took a leading part in the establishment of cremation in this country as a proper method of disposal of the dead, and was president of the Cremation Society from its foundation in 1874. He was the author of numerous works, including volumes and papers on the branches of surgery in which he was an acknowledged master, on motor cars, horses, diet and death certification, and also of two novels. For several years he cultivated astronomical studies, and had a well equipped observatory constructed at Molesey, but this was abandoned after a time, and the two fine refractors were presented to the Royal Observatory, Greenwich. Later, in 1897, Sir Henry Thompson added to his gift the thirty inch photographic reflector which bears his name. He was knighted in 1867 and created a baronet in 1899, and was the recipient of many honours and distinctions from professional and other learned societies, both at home and abroad.

PROF. C. L. BRISTOL, professor of biology, New York University, asks us to announce that English and Continental naturalists will be gladly welcomed at the Bermuda Biological Station for Research. Harvard University and New York University unite with the Bermuda Natural History Society in inviting zoologists and botanists to spend six weeks in this temporary biological station, to be situated, as last year, at the Flatts, Bermuda. The laboratory is a new building, and is furnished with all the ordinary glassware, reagents and apparatus provided in modern marine laboratories; but microscopes, dissecting instruments, slides and cover glasses are not supplied by the station. The means of collecting include a steam launch forty-five feet long and crew, a fish-well sailboat and crew, rowboats, a two-horse carriage carrying ten or twelve persons, nets, seins, water glasses, towing and dredging apparatus, &c. Zoologists and botanists who desire to take advantage of the opportunities offered by the station should send applications as early as possible, and not later than May 1, either to Prof. E. L. Mark, 109 Irving Street, Cambridge, Mass., or to Prof. C. L. Bristol, New York University, University Heights, New York City.

THERE is at Durango, Mexico, a great mass of iron ore which has figured in story and fable for 300 years, and was thought to be a meteorite by Humboldt, who, however, did not quite reach Durango in his explorations. Mr. Le Roy, the United States Consul at Durango, now reports that the mass proves to be a remarkable dyke, emerging from a rocky plain at the elevation of 6300 feet, rising from 400 feet to 650 feet in height itself, and forming a mass of iron ore a mile long and one-third of a mile wide. It has been calculated that it contains 500 to 660 million gross tons above the surface, while there are no means of knowing

what may be below. The ore is a hard specular hematite, with, on an average, 60 per cent. of metallic iron, much of it going up even to 67 per cent.

THE recent annual presidential address of Mr. T. Fairley to the Society of Analysts has been published as a separate pamphlet, a copy of which has reached us. The president, we notice, directed attention to the fact that we are falling behind both Germany and America in research work in analytical chemistry, and proceeded to urge each member of the society to do his utmost, not only to remove this reproach, but to seek to restore to this country a front rank in the cultivation of this branch of chemistry.

THERE was a considerable attendance at the triennial meeting of the German Meteorological Society held at Berlin during Easter week, under the presidency of Prof. von Bezold, the meetings being held at the Institut für Meereskunde. Numerous papers were read and discussed, those on April 7 and 9 being mainly meteorological, and those on April 8 electrical and magnetical, the one which occasioned the most animated discussion being communicated by Prof. Holdefleiss, Halle—"Ueber die meteorologischen Ursachen des Auswinterns des Getreides." On the afternoon of April 7 the members were conducted over the Meteorological Institute in the Schinkelplatze; that of April 8 was devoted to the Physical Observatory at Potsdam; that of April 9 to the meteorological and military balloon and kite flying establishments at Tegel, and the evening to the Geographical Society's meeting; and Sunday evening to the Astronomical Observatory at Treptow. At Tegel the Luftschiff military section charged a balloon of 600 cubic metres within three minutes; within fifteen minutes it had been attached to its car, and, with two officers on board, had disappeared beyond the clouds. The military authorities also carried out wireless telegraphy experiments by means of kites. Dr. Assmann, in charge of the meteorological station, had observations taken at a considerable elevation by means of a kite, and also dispatched a small rubber free balloon with a set of instruments attached.

IN accordance with an imperial decree, the duties of the Earthquake Committee of the Academy of Sciences of Vienna have been transferred to the Central Meteorological Office, the director of which is Dr. J. M. Pernter. The title of the institution is now changed to K.k. Zentralanstalt für Meteorologie und Geodynamik.

IN our issue of December 10, 1903 (p. 135), attention was directed to some of the leading features of a paper read by Dr. H. R. Mill at a meeting of the Institution of Civil Engineers on November 24, on the mean and extreme annual rainfall over the British Isles. A complete copy of this valuable paper has now been received, containing an abstract of the discussion upon it. It is accompanied by three tinted maps showing respectively the mean rainfall in 1870–99, the maximum rainfall in 1872, and the minimum in 1887. There are also three outline maps showing the positions of stations used, and the distribution of the extremes of annual rainfall, the years of occurrence being entered in the geographical positions of the stations. A glance at the map of stations shows that great care has been exercised in their selection, and that materials were forthcoming (except in one or two of the Irish districts) for a remarkably uniform distribution of stations over the whole of the British Islands.

THE great dustfall of February, 1903, has been discussed by Dr. H. R. Mill and R. G. K. Lempfert, and the results published in the *Quarterly Journal* of the Royal Meteorological Society of January last. Before the completion of this investigation an elaborate discussion of the same phenomenon was published by Dr. E. Hermann, of Hamburg, in the *Annalen der Hydrographie* for October and November, 1903. The English authors have approached the subject from a somewhat different point of view from that taken by Dr. Hermann, and have concerned themselves mainly with the relation between the fall of dust and the larger motions of the atmosphere, illustrated by a series of maps embracing the North Atlantic and the western portion of Europe. They have also paid more particular attention to the fall over the British Islands. The area over which it fell thickly in England and Wales is estimated at not less than 20,000 square miles, to the south of a line drawn from Anglesey through Wrexham and Northampton to Ipswich, and the total deposit in England is estimated at not less than ten million tons. There is strong evidence in favour of the dust being of African origin, and that it travelled at a very high altitude. The paper includes some interesting descriptions of competent observers, and a valuable note of a microscopical examination of a number of specimens of the dust by Dr. J. S. Flett, of H.M. Geological Survey.

PROF. H. F. OSBORN sends us an interesting photograph of the Tasmanian wolf taken by Mr. E. T. Keller, and here reproduced. The photograph illustrates an interesting observation made by Mr. Keller that in the resting position

FIG. 1.—Resting Position of the Tasmanian Wolf.

the stiff tail is used to support the animal. Prof. Osborn remarks:—"I have not seen this interesting fact recorded elsewhere. It is, however, possible that it is well known among students of the habits of this animal."

THE occasional appearance during winter of pipistrelle bats, hedgehogs, and frogs, according to a paper by Mr. C. B. Moffat in the April number of the *Irish Naturalist*, is, in Ireland at any rate, much more frequent than is commonly supposed. In the same issue Mr. G. C. Gough discusses the formation of iron-ore in Lough Neagh, and concludes that this is chiefly due to the decomposition of the magnetite in the surrounding rocks.

AMONG the contents of the *Jahrbuch* of the Nassau Naturalists' Union, published at Wiesbaden, is an article by the editor, Dr. A. Pachenstacher, on the hawk-moths and Bombycidæ collected by Baron Carlos von Erlanger during his travels in Shoa, Gallaland, and Somaliland in 1900 and 1901. In another paper Dr. W. Schuster describes the enormous number of long-eared owls nesting in the warm Mayence basin.

Following its removal to surroundings better suited to studies of this nature, Christ's Hospital, Horsham, has founded a natural history society of its own, the first report of which is now before us. Naturally, the start has been somewhat uphill work; but, nevertheless, considerable progress has been made, and all the sections are in working order. Funds appear to be much needed for the museum.

To the February issue of the *Proceedings* of the Philadelphia Academy Mr. J. A. G. Rehn contributes a paper on the Central and South American bats of the genus Chilonycteris, in which all the species are critically reviewed. The most striking feature about these bats is the occurrence of a rufous and a dark brown phase in each species. In some the two phases are very marked, but in others they are connected by intermediate shades. It is not stated whether the two phases (which also occur in bats of two allied genera) have any connection with locality.

In the report of the Trivandrum Museum for 1903 attention is directed to two dolphins obtained during the year. One has been identified by Mr. Lydekker with *Tursiops catalania*, hitherto known only from Australian seas, while the second has been made the type of a new species, *Sotalia fergusoni*. Descriptions of both were sent to the Bombay Natural History Society. Mr. Ferguson, who is about to retire from the post of director, summarises the progress that has been made in the museum during his term of office. When he took over the duties in 1888 the collection consisted of "odds and ends," without any representation either of the arts and manufactures or of the fauna of Travancore. This "curiosity shop" has been replaced by a representative series of local arts and manufactures, as well as by nearly complete collections of the vertebrates.

An important paper, by Dr. Bashford Dean, on the hag-fishes of Japan, is published in the *Journal* of the Tokyo University School of Science (vol. xix. art. 2). Two new species are described, one remarkable for its large size and the normal possession of eight gill-openings, and the other constituting a new generic type (Paramyxine). Japan appears to be the most favourable locality at present known for the study of hag-fishes. "In no other known locality are four species, representing three genera of these important chordates, found living practically side by side—for in the neighbourhood of Misaki they occur within a distance of 30 kilometres. Here, too, a form of myxinoid can be obtained in greater abundance than in any locality known to me, and there is also a promising field for collecting developmental stages."

The "Nature of Heredity" forms the subject of an address delivered in April, 1903, before the South African Association for the Advancement of Science by Dr. A. Dendy, which is published in the first volume of the report of that body. To give a summary of the author's arguments in such a difficult subject would far exceed the limits of our space, but it may be mentioned that Dr. Dendy is of opinion that the views of the late Prof. Cope on heredity come nearer the truth than those of any other writer. There are three special points:—(1) the importance of the cell-nucleus as an apparatus for storing up and giving out stimuli; (2) the possibility of the transference of stimuli between somatic cells and germ-cells (or their nuclei) without any material connection; and (3) the extension of what may be called Herbert Spencer's principle of equilibration to the phenomena of heredity and development, to which, in Dr. Dendy's opinion, sufficient consideration has not been given.

The submarine valleys off the American coast and in the North Atlantic are described by Prof. J. W. Spencer (*Bull. Geol. Soc. America*, vol. xiv.), who sees evidence in these drowned lands of canyons and other deeply excavated features.

Some Jurassic fossils from Rikuzen, in Japan, are described by Prof. Matajiro Yokoyama (*Journ.* Coll. Sci., Tokyo, vol. xviii.). These include Schlotheimia, Lytoceras (near to *lineatum*), and other ammonites, as well as belemnites; also *Trigonia v-costata*, and species of Gervillia and Perna.

We have received several of the *Bulletins* of the Geological Survey of Western Australia. Among these, No. 10 contains descriptions, by Mr. R. Etheridge, of Carboniferous fossils from the Gascoyne district; No. 9 is on the lead and copper ores of Northampton, by Mr. A. Gibb Maitland; and No. 8 is on the Murchison goldfield, by Mr. C. G. Gibson.

In a lecture on the Assuân Reservoir and Lake Moeris (E. and F. N. Spon, 1904), Sir William Willcocks advocates the formation of a modern Lake Moeris to the south of the ancient lake which for more than 2000 years served to control the floods of the Nile. The new lake would occupy the Wadi Rayan depression. In support of his argument that further measures are necessary, he mentions that since the Assuân dam was completed the whole of the water has been devoted to special tracts, and the Government is reluctantly compelled to refuse further applications for water.

The fundamental facts of statical electricity are concisely described, with illustrative experiments, by Herr B. Kolbe in his "Einführung in die Elektrizitätslehre, I. Statische Elektrizität," of which a second revised edition has been published by Herr Julius Springer, Berlin.

Messrs. Isenthal and Co., 85 Mortimer Street, London, W., have published a new illustrated catalogue of apparatus for electrotherapy. The illustrations and descriptions of the apparatus are of a very instructive character. Among other instruments included may be mentioned the Röntgen ray apparatus of all kinds, that for the therapeutical uses of currents of high frequency and high potential, and that for photo- and thermotherapy.

The Geological Survey of Canada has published a report on "Altitudes in the Dominion of Canada," by Mr. James White, geographer to the Department of the Interior. The report is accompanied by an excellent relief map of North America, and by four sheets of profiles. Three sheets are concerned with the Canadian Pacific Railway—this railway being chosen as showing the profile of the country along the only transcontinental line in Canada—and one shows the River St. Lawrence and the Great Lakes.

The report of the first meeting of the South African Association for the Advancement of Science, held in April of last year, has been received. It is unnecessary to enumerate in detail the contents of the volume, which runs to 556 pages, for the chief events of the meeting were described in our issue for May 21, 1903 (p. 59). The presidential address by Sir David Gill, F.R.S., and the addresses of the presidents of the four sections into which the work of the association was divided, are all printed at length. Meteorological papers were numerous and important in Section A, though the other subjects, chemistry, astronomy, mathematics, and physics, with which the section is also concerned, are all represented. The subjects in Section B

were chiefly of a biological and geological character; in Section C various engineering questions were discussed, and in Section D great prominence was given to education, philosophy and sociology. The volume deals with forty-seven papers, which are with a few exceptions printed in full or abstracted.

Up to the present the alloys of nickel and iron have attracted attention chiefly on account of the fact that alloys containing about 35 per cent. of nickel have an exceedingly small coefficient of expansion, which in certain cases may even become negative. Their elastic properties appear, however, to be of equal interest and importance, and a paper on this subject, by M. Guillaume, in the *Séance* of the French Physical Society, contains a number of important data. At ordinary temperatures the modulus of elasticity reaches a maximum at 29 per cent. and a minimum at 45 per cent. of nickel, and between these limits the modulus of elasticity *increases with the temperature*, whilst two alloys must exist in which the modulus is independent of the temperature. These results can be explained by supposing that the change from β to γ iron is accompanied by a large increase in the modulus of elasticity, and that in the alloys referred to this transition is brought down to the ordinary temperatures and extended over several degrees.

In recent months some attention has been paid to the problem of bringing about electrolytic decomposition by means of alternating currents. The most important paper that has appeared on the subject is that by Le Blanc and Schick in the *Zeitschrift fur physikalische Chemie*, in which experiments are described on the dissolution of metals in various solvents by the aid of alternating currents of frequency ranging from 72 to 38,600 alternations per minute. In the simpler cases, such as the dissolution of copper in sodium hydrogen sulphate, the weight of metal dissolved is very small, and even at a frequency of only 72 is less than one-third of that calculated from Faraday's law. On the other hand, potassium cyanide, especially in concentrated solutions and with a high current density, dissolves the metal freely even with very high frequencies, and in one experiment the weight of copper dissolved amounted to no less than 66 per cent. of the theoretical quantity when the frequency was above 30,000; this result is probably due to the formation of complex double cyanides in which the metal forms part of the acid radicle, and so is hindered from being re-deposited on the electrode.

The additions to the Zoological Society's Gardens during the past week include a Campbell's Monkey (*Cercopithecus campbelli*) from West Africa, presented by Mr. J. A. L. Campbell; a Vulpine Phalanger (*Trichosurus vulpecula*) from Australia, presented by Mr. Herbert A. Parkes; an African Civet Cat (*Viverra civetta*) from Africa, presented by Lieut. H. Nelson, R.A.; three Reeve's Pheasants (*Phasianus reevesi*) from northern China, presented by Miss J. Mann; a Blue-fronted Amazon (*Chrysotis oestiva*) from South America, a Princess of Wales's Parrakeet (*Polytelis alexandrae*) from Australia, presented by Mrs. St. Clair Christophers; a Bonnet Monkey (*Macacus sinicus*) from India, a Blackish Macaque (*Macacus fusco-ater*) from the Celebes, a Striped Hyæna (*Hyaena striata*) from North Africa, a Virginian Opossum (*Didelphys virginianus*) from North America, a Burrowing Owl (*Speotyto cunicularia*) from South America, a Grey Parrot (*Psittacus erithacus*) from West Africa, five Eyed Lizards (*Lacerta ocellata*), south European, deposited; a Mouflon (*Ovis musimon*), born in the Gardens.

OUR ASTRONOMICAL COLUMN.

Return of Brooks's Comet.—A telegram received from the Kiel Centralstelle on April 17 announces that Brooks's comet was observed at Geneva at 9h. 50m. (Geneva M.T.) on April 16. Its position at that time was R.A. = 16h. 58m. 8s., decl. = +44° 10′, and it was slowly travelling northward. Both a nucleus and a tail were seen.

A second telegram received on April 18 announces that Prof. Kobold observed the comet on April 17, and found its position, at 11h. 34m. 0s. (Kiel M.T.), to be R.A. = 16h. 56m. 23·8s., decl. = +44° 43′ 47″.

The above data show that on April 16 the comet was nearly on a straight line joining σ and ι Herculis, and rather nearer to the former than the latter, also that the comet is apparently travelling towards Draco.

Absorption of Star-light by a Comet's Tail.—In No. 3914 of the *Astronomische Nachrichten* Dr. Max Wolf discussed a photograph which led him to the conclusion that the light of the star B.D. + 63°·1056 was affected by selective absorption in passing through the tail of comet 1903 IV. on July 25, 1903.

The consideration of later observations has led him, however, to doubt the reality of the apparent absorption, which he now considers may have been due to a photographic effect produced by the comet's light on the film of the negative (*Astronomische Nachrichten*, No. 3934).

The Spectra of Novæ.—In an article published in No. 3917 of the *Astronomische Nachrichten*, Herr H. Ebert explains how the multiple character of the lines in the spectra of new stars may readily be accounted for by supposing it to be due to "anomalous refraction" in the layers of vapours, of different characters and densities, through which the light has to pass between the source and the observer. By a number of curves and diagrams he shows that in the complex strata, which may be reasonably supposed to exist in the vapours surrounding a new star, the light would be refracted hither and thither until, when it emerged from the outer layers, the distribution of the brightness in the spectrum would have been considerably modified by anomalous refraction.

The "shifting" of spectral lines in the experiments which have been performed by several observers on the spectrum of the spark discharge under various liquids may, according to Herr Ebert, be readily explained by this theory.

Nebulosity Around Nova Persei.—In No. 2, vol. xix., of the *Astrophysical Journal*, Mr. Otto Luyties, of Baltimore, discusses the theories which have been promulgated in reference to the nature and the expansion of nebulosity around Nova Persei, and points out the effect which the shape of the body concerned might have upon the observed velocities. He states that the previous estimations of the parallax of the Nova nebula and of the rate of its expansion have been partly based on the probably erroneous assumption that the emanations which caused the illumination were originally propagated in a direction at right angles to the line of sight. If, however, the mass illuminated were spherical in form, the resulting distortion on the photographic plate would lead to serious misconceptions as to the rate of expansion and the nature of the emanation. Mr. Luyties then discusses the possible effects of such distortion, both for the case of radial illumination from the centre and for that in which the emanation proceeded from a point on the boundary of the sphere, and shows that the correction for such distortion, when a likely value is allotted to the parallax, could be made to account readily for the apparent retardation of the illuminations, and for other anomalies which have been observed, when the actual velocity of the emanations was of the order of that of light.

Stellar Distribution.—A communication from Mr. J. E. Gore to No. 343 of the *Observatory* gives the results obtained from a count of the stars of each magnitude from the third to the sixteenth on a chart of the Pleiades published in Klein's Star Atlas. This chart covers three square degrees, and Mr. Gore finds that the actual value of the ratio for all magnitudes is considerably less than 4, which is the theoretical value if all the stars were equally distributed in space.

The total number of stars counted on the chart was 1281, and this would give for the whole sky, if of uniform richness, a total of 17,615,031.

THE MULTIPLE ORIGIN OF HORSES AND PONIES.[1]

HITHERTO it has been generally assumed that wild horses have been long extinct, that all domestic horses are the descendants of a single wild species, and that, except in size, ponies in no essential points differ from horses.

Now that systematic attempts are being made to improve native breeds of horses in various parts of the world, it is obviously desirable to settle once for all whether, as is alleged, occidental as well as oriental and African races and breeds have sprung from the same wild progenitors, and more especially if *all* ponies are merely dwarf specimens of one or more of the recognised domestic breeds of horses.

To be in a position to arrive at a conclusion as to the origin of the various kinds of domestic horses, and at the same time find an answer to the important and oft-repeated question, What is a pony? one must clear up as far as possible the later chapters in the history of that section of the Equidæ to which the true horses belong.

It is generally admitted that the ancestors of the living Equidæ reached the Old World from the New, the later immigrants crossing by land bridges in the vicinity of Behring Straits. If horses came originally from the New World, to the New World we may first turn for information as to their remote progenitors.

According to recent inquiries, North America possessed in pre-Glacial times at least nine perfectly distinct wild species of Equidæ. Some of these were of a considerable size—*e.g.* *Equus complicatus* of the southern and middle western States, and *E. occidentalus* of California were as large as a small cart-horse. Others were intermediate in size—*e.g. E. fraternis* of the south-eastern States; and at least one—*E. tau* of Mexico—was extremely small. Some of the American pre-Glacial Equidæ were characterised by very large heads and short strong limbs, some by small heads and slender limbs; and though the majority conformed to the true horse type, two or three were constructed on the lines of asses and zebras.

When true horses first made their appearance in America the climate and the land connections between the Old World and the New were very different from what they are to-day. One result of these differences was that before the close of the Pliocene period—*i.e.* prior to the great Ice age—it was possible for American horses to find their way into Asia and thence into Europe and Africa. One of the earlier immigrants (*Equus stenonis*) has left its remains in the Pliocene deposits of Britain, France, Switzerland, Italy, and the north of Africa. While *E. stenonis* was extending its range into Europe and Africa, two others (*E. sivalensis* and *E. namadicus*) were finding their way into India, and yet other species were doubtless settling in eastern Europe and Central Asia.

It may hence be safely assumed that as Africa now contains several species of zebras, Europe at the beginning of the Pleistocene period was inhabited by several species of horses.

We know that before the beginning of the historic age horses had become extinct in North America, but we have not yet ascertained what was the fate of the equine species which reached, or were evolved in, the Old World before or during the great Ice age. It is believed by some palæontologists that the Indian species, *E. sivalensis* and *E. namadicus*, became extinct, and that *E. stenonis* gave rise through one variety (*E. robustus*) to the modern domestic breeds, and by another (*E. ligeris*) to the Burchell group of zebras. *E. sivalensis*, unlike *E. stenonis*, but like the still earlier three-toed horse Hipparion and certain prehistoric South American species, was characterised by a depression in front of the orbit for a facial gland (probably similar to the scent-gland of the stag), and usually by large first premolar (wolf) teeth in the upper jaw. In some recent horses having eastern blood in their veins there seems to be a vestige of the pre-orbital depression, and in some of the horses of south-eastern Asia (*e.g.* Java and Sulu ponies), as in some zebras (*e.g.* Grévy's zebra and a zebra of the Burchell type found near Lake Baringo), there are large functional first premolars. It is hence possible that lineal but somewhat modified descendants of *E. sivalensis* of the Indian Pliocene may still survive, and that *E. sivalensis* was a lineal descendant of Hipparion.

We are, however, more concerned with the ancestors of the domestic horses of Europe and North Africa than with oriental horses.

From osseous remains already found we know horses were widely distributed over Europe during the Pleistocene period, and that they were especially abundant in the south of France in post-Glacial times. It has not yet, however, been determined how many species of horses inhabited Europe during and immediately after the Ice age, nor yet to which of the pre-Glacial species prehistoric horses were genetically related. Bones and teeth from deposits and caves in the south of England seem to indicate that during the Pleistocene period several species of horses ranged over the west of Europe. The Pleistocene beds of Essex have yielded bones and teeth of a large-headed, heavily built horse, which probably sometimes measured more than 14 hands (56 inches) at the withers. From the "elephant bed" at Brighton portions of a slender-limbed horse have been recovered, and Kent's cave, near Torquay, has yielded numerous fragments of two varieties or species which differed somewhat from the Essex and Brighton species. The "elephant-bed" horse has hitherto been described as very small, but if one is to judge by the bones in the British Museum it may very well have reached a height of 50 or even 52 inches (12·2 or 13 hands). The Kent's cave horses were probably from 13 to 14 hands high. One in its build approached the Essex horse, the other the slender-limbed species of the "elephant bed" at Brighton. If there were two or more species in Pleistocene times in the south of England (then part of the Continent), it is probable that yet other species inhabited south and middle Europe and the north of Africa.

As already mentioned, horses were extremely abundant in the south of France in the not very remote post-Glacial period.[1] Evidence of the existence of large herds we have at Solutré, where for a number of years there was an open-air Palæolithic encampment. Near the Solutré encampment (which lies in the vicinity of the Saône, about midway between Chalons and Lyons), the bones of horses[2] and other beasts of the chase were sufficiently abundant to form a sort of rampart around part of the settlement. It is difficult to say how many species of horses are represented at Solutré, but there seems no doubt that the majority belonged to a stout, long-headed, but short-limbed animal, measuring about 54 inches (13·2 hands) at the withers. Though of smaller size, the typical Solutré horse had nearly as large joints and hoofs as the Essex Pleistocene species. Like the Essex horse, it seems to have been specially adapted for living in low-lying marshy ground in the vicinity of forests, and for feeding during part of the year on coarse grasses, shrubs, roots, and other hard substances, for the crushing of which large teeth set in long powerful jaws were indispensable.

That lightly built as well as stout species existed in post-Glacial as in Pleistocene times is made evident by bones found in caves and by drawings and sculptures made by Palæolithic hunters. Of the existence of two kinds of horses in post-Glacial times, practically identical with the stout and slender-limbed Pleistocene species, the cave of Reilhac, near Lyons, is especially eloquent. It is, however, mainly by the engravings on the walls of caves in the Dordogne, Gard, and other districts in the south of France that the existence in late Palæolithic times of various kinds of light and heavy species of horses is made manifest.

In the cave of La Mouthe, *e.g.*, two horses are incised on the same panel—perhaps by the same hand—one of which (Fig. 1) has a very long head attached nearly at right angles to a short thick neck, while the other has a small head, Arab-like ears, and a long slender neck such as we are wont to associate with racehorses.

In the Combarelles cave (Commune of Tayac), the walls

[1] By Dr. J. Cossar Ewart, F.R.S. Abridged from *Trans.* Highland and Agricultural Society of Scotland, vol. xvi., 1904.

[1] An account of the prehistoric horses of Europe, by Dr. Robert Munro, will be found in the *Archaeological Journal*, vol. lix. No. 234.

[2] Toussaint, of the Lyons Veterinary College, believes that at Solutré there were fragments of at least 100,000 horses, all of which had been used as food.

of which for more than a hundred yards are crowded with animal figures, there are, in addition to twenty-three nearly full-sized engravings of horses, numerous studies of equine heads. Some of the Combarelles horses decidedly differ from those of La Mouthe. There is, *e.g.*, a large drawing of a heavily built horse (Fig. 2) with a coarse head, an arched muzzle, a thick under lip, rounded quarters, and a tail with long hair up to the root. At another part of the cave there is what appears to be a natural size engraving (Fig. 3) of a head which in outline is wonderfully suggestive of an Arab, and at yet another part of the cave a horse with a pony-like head is represented, behind which stands an animal with a head like that of a modern Shire horse.

FIG. 1.—Horse with a long head, from an engraving in the cave of La Mouthe. (Munro's "Prehistoric Horses.")

In addition to the types figured on the walls of caves, there are others carved on pieces of horn and other durable substances. The majority of the horses engraved on horn are characterised by a very large coarse head, but a few (*e.g.* the horse from the Kesserloch cave near Schaffhausen) are remarkable for the small size of the head, the fine muzzle, and small ears.

As already indicated, the men of the early Stone age have left us drawings of some four or five different kinds of horses, some with large heads and stout limbs, some with fine heads and slender limbs, some with a nearly straight croup and a well-set-on tail, others with rounded quarters and the root of the tail far below the level of the croup. Drawings made at the present day will be of little use some centuries hence in providing an answer to the question, How many species of horses existed in Europe at the beginning of the twentieth century? They will confuse rather than enlighten future inquirers, because for several generations breeders of horses, like breeders of cattle and dogs, have with the help of selection and isolation succeeded in creating numerous artificial strains. Is there any reason for supposing the evidence afforded by the prehistoric drawings is more valuable to us than recent drawings will be to our successors thousands of years hence, should they desire to ascertain how many species of horses Britons possessed at the end of the nineteenth century? That depends on whether in Palæolithic times the horse was domesticated in Europe.

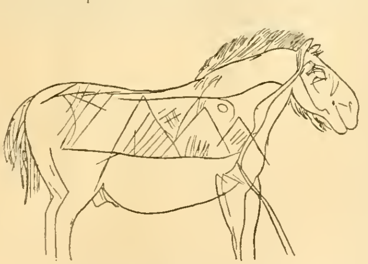


FIG. 2.—Engraving of a beavily built horse, from the Combarelles cave ($\frac{1}{7}$). (Munro's "Prehistoric Horses.")

It is extremely probable that the men of the early Stone age had now and again tame horses, just as nowadays we have at times tame zebras, but it is most unlikely that they had herds of horses which they systematically bred and reared as stockmen now breed and rear cattle.

That the domestication of the horse as now understood was not attempted in Palæolithic times may be inferred from the fact that the majority of the horses in the Solutré bone-mounds were from five to seven years old. Had horses been bred for food as we nowadays breed cattle, young individuals would have been most abundant at Solutré.

If it is admitted that the engravings on the walls of caves and on pieces of horn fairly accurately represent animals which actually existed at the end of the Ice age, and if it is also admitted that the creation of new varieties by artificial selection was never attempted until at the earliest the arrival of the Neoliths, it follows that in post-Glacial as in Pleistocene times there were several perfectly distinct wild species of horses in Europe.

For some reason or other it has hitherto been very commonly assumed that, as in recent times the wild striped horses of South Africa—the quagga and zebras—have been gradually supplanted by occidental or oriental domesticated horses, the wild horses of Europe were gradually displaced by domesticated varieties introduced by the Neoliths. It seems to me quite unnecessary to assume that the indigenous varieties so long familiar to the Palæolithic inhabitants were exterminated.

The advent of the Neoliths, instead of implying the extermination of indigenous varieties, in all probability meant the introduction of yet other varieties.

I may here repeat that now, as throughout the nineteenth century, it is generally assumed that all the domestic breeds—small as well as large—have sprung from a single wild species. The great French naturalist Cuvier not only believed that all living horses belonged to one species (the *Equus caballus* of Linnæus), but also that there was no specific difference between living breeds and the fossil horses of the Pleistocene period. Prof. Sanson, of the French National College of Agriculture, in his "Traité de Zootechnie" (1901), assuming a single origin for domestic breeds, divides recent horses into two groups—a long-headed and a short-headed group—each of which consists of several races, while Captain Hayes, in his recently published "Points of the Horse" (1904), says, "no breed of horses possesses any distinctive characteristic which serves to distinguish it from other breeds," and adds that "as a rule locality . . . and artificial selection are the chief factors in the formation of breeds." Elsewhere Captain Hayes states, "As far as I can learn, no attempt has been made to separate ponies from horses except on the purely artificial basis of height."[1] Even those who are prepared to admit that recent horses may have sprung from several wild species allege that owing to domestication, intercrossing, and artificial selection it is no longer possible to indicate the distinguishing characters of the two or more wild species which took part in forming the present races and breeds.

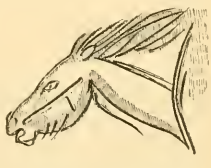


FIG. 3.—Head of a horse with a profile like that of an Arab, from the Combarelles cave ($\frac{1}{8}$). (Munro's "Prehistoric Horses.")

THE WILD HORSE (*Equus caballus prjevalskii*).

The wild horse may be first considered. For many years the semi-wild Tarpan of the Russian steppes was regarded as the nearest living relative of the wild ancestor of the domestic breeds, but in 1881 the existence of a true wild horse was announced by the Russian naturalist Polyakov. This horse occurs in the vicinity of the Gobi desert and the Great Altai Mountains, one variety living to the south-east, another to the west, and a third to the south of Kobdo. All three varieties are of a yellow-dun colour, the south-eastern (Zagan-Nor) form being especially characterised by a dark muzzle, dark points, and a dark mane and tail; in the western (Urungu) variety the muzzle is nearly white, the limbs are light down to the fetlocks, and the mane and tail are of a reddish-brown tint, the southern (Altai) form being nearly intermediate in its coloration. The markings consist of a narrow dorsal band, faint indications of shoulder stripes, and indistinct bars in the region

[1] "Points of the Horse," pp. 422–425.

of the knees and hocks. In all three varieties the mane is short and upright in the autumn, but long enough in spring to arch to one side of the neck; in summer the upper two-thirds of the dock of the tail carries short hair, the distal third long hair, which continues to grow until it reaches the ground; in winter the upper two-thirds of the tail carries hair from 2 to 4 inches in length. The hair of the body and limbs is short in summer, but under the jaw and over the greater part of the body and limbs it is from 3 to 4 inches in length in winter.

The hoofs are narrower and have longer "heels" than in the common horse, but, as in the common horse, each limb is provided with a chestnut and with an ergot, the hind chestnut (hock callosity) being very long and narrow.

In the variety (Fig. 4) occurring in the Altai south of Kobdo—probably the most primitive of the three—the head is large and coarse, and, compared with the length of the body, longer than in any domestic breed. In a side view it is noticed that the forehead is prominent (bumpy), the lower part of the face straight or slightly convex, the under lip long, and that the head forms nearly a right angle with the short neck. The eyes are lateral in position, and appear unusually close to the ears owing to the great length of the space between the eye and the nostril. The ears are long and generally project obliquely outwards (Fig. 4), as in many cart-horses. The croup is nearly level, but the hocks are usually bent and turned in. Judging by the behaviour, during the last two years, of the wild horse in my possession, I am inclined to think his less remote ancestors, though in all probability members of the steppe fauna, lived for a time (perhaps during the Ice age) in the vicinity of forests. As is the case with other gregarious animals, he strongly objects to be separated from his companions, and he also objects to have his movements circumscribed by fences. It has often been said "nothing jumps better than a cart colt." The cart colt jumps because he has sprung from big-jointed, broad-hoofed, forest-haunting ancestors whose existence often depended on their being able at a bound to clear fallen trees and other obstacles. The wild horse when shut up in a loose-box by himself is very restless, and keeps rearing up against the door until set at liberty; if placed in a paddock away from his special comrades he generally succeeds in either scrambling over or breaking down the fence.

The wild horse never encounters fences in the Gobi desert, but, probably because he had forest-bred ancestors which had often to cross fallen trees, he endeavours without a moment's hesitation to clear all obstacles that come in his way, while true desert forms endeavour to break through them.

It has been suggested that the wild horse of the Gobi desert is not a true wild animal, but only a domesticated breed that has reverted to the wild state.[1] Against this view I may mention (1) that all the wild horses are of a yellow-dun colour, and that though those to the west of Kobdo differ in tint from those to the east, the eastern and western varieties seem to be connected by the less specialised variety to the south of Kobdo; (2) that travellers in Central Asia all agree in stating that the Mongolian ponies vary greatly in colour—in a Chinese hymn known as the "Emperor's Horses" as many as thirteen colours are referred to; (3) the descendants of the horses which escaped from the Spaniards in America after several centuries of freedom were of all sorts of colours; and (4) in horses which live in sub-Arctic areas the hair at the root of the tail tends to increase so as to form a sort of tail-lock, which when caked with snow protects the hind-quarters during snowstorms; the complete absence of this tail-lock—fairly well developed in one of my Mongolian ponies—is a very strong argument against the assumption that Prjevalsky's horse is nothing more than a domesticated breed that has reverted to the wild state.

The wild horse of the Gobi desert is certainly the least specialised of all the horses living at the present day. In being of a yellow-dun colour, in shedding annually the hair of the mane and the hair from the upper two-thirds of the tail, in having ergots and chestnuts on the hind- as well as on the fore-limbs, and in having canines and fairly large upper first premolars, Prjevalsky's horse is distinctly primeval. Only in the all but complete absence of stripes and in having very long powerful jaws armed with relatively large teeth can the Gobi horse be said to be specialised.

It is extremely probable that Prjevalsky's horse was familiar to the troglodytes who inhabited the Rhone valley in prehistoric times. One might even go further and say that in Fig. 1, from an engraving in the cave of La Mouthe, we have a fairly accurate representation of the head of Prjevalsky's horse.

It is, of course, impossible to say which of the recent breeds are most intimately related to the Gobi horse. Though the head and ears are suggestive of some of the heavier occidental breeds, in its trunk and limbs it more closely resembles Mongolian and Korean horses, some of which, like Prjevalsky's horse, decidedly differ from Shires and Clydesdales in having a small girth owing to a want of depth of body. To which domestic breeds the wild horse has contributed characters will probably become more manifest after he has lived for some time under domestication. That heavy occidental breeds are not pure descendants of Prjevalsky's horse is suggested by the fact

Photograph by M. H. Hayes.

FIG. 4.—Prof. Ewart's yearling wild horse in summer coat. (From Hayes' "Points of the Horse.")

that cart-horses, like zebras, have usually six lumbar vertebræ—the wild horse of Asia has only five, like the wild asses.

THE CELTIC PONY (*Equus caballus celticus*).

From the most primitive member of the Equidæ family I shall turn to the most specialised, viz. to what I have ventured to call the Celtic pony.

In colour and markings a typical Celtic pony only differs from the intermediate (Altai) variety of the wild horse in having a slightly darker muzzle, a less distinct light ring round the eye, and a more distinct dorsal band. The hair is similar in structure, but slightly longer in the Celtic pony during winter (Fig. 5), more especially under the jaw—where it forms the so-called beard—over the hind-quarters, and on the legs. In the mane, tail, and callosities the Celtic pony is very different from the wild Gobi horse. The mane is made up of a mesial portion (nearly twice the width of the entire mane in an Arab) consisting of strong dark hair, and of two lateral portions the hair of which is lighter and finer and less circular in section than the hair of the central portion. The mane in the adult grows at the rate of from 9 to 10 inches per annum, and as only about one-third of the hair is shed annually, the mane

[1] It was formerly stated that the wild horse was simply a hybrid between a Mongolian pony and a kiang. I recently showed that a hybrid of this kind is quite different from the wild horse. See *Proc.* Roy. Soc. Edin., vol. xxiv. part v., 1902–1903, and NATURE, vol. lxviii. p. 271.

reaches a considerable length. Owing to the great width of the middle portion the one half of the mane generally falls to the right side, the other to the left. The front part of the mane hangs down over the face to form a forelock (Fig. 5).

Photograph by G. A. Ewart.

FIG. 5.—A typical Celtic pony in winter coat. (Note the "beard," forelock, and tail-lock.)

The most remarkable feature of the Celtic pony is the tail. To begin with, the dock is relatively very short—so short that one is apt to suppose it has been docked. The distal two-thirds of the dock carries long dark hairs, the majority of which continue to grow until they trail on the ground. During winter and spring the proximal third of the dock—about 4 inches—carries stiff hair from 3 to 6 inches in length, which forms what may be known as a caudal fringe or tail-lock (Figs. 5 and 6). In the case of Arabs and other semi-tropical horses the first 1 or 2 inches of the dock are usually covered with short fine hair like that over the hind-quarters, but in the Celtic pony fine wiry hairs from 4 to 5 inches in length extend right up to the root of the dock under cover of the body hair of the croup. The most distal hairs of the tail-lock overlap, but are quite distinct from, the long persistent hairs carried by the lower two-thirds of the dock. The hair in the centre of the fringe of the same colour as the dorsal band (Fig. 6), projects obliquely backwards; the hair at the sides is light in colour and projects obliquely outwards. The presence of this very remarkable bunch of hair at the root of the tail was quite incomprehensible until I noticed what happened during a snowstorm. The moment the storm set in the pony orientated herself so that the snow was driven against her hind-quarters. In a few minutes the lock of hair was spread out to form a disc, to which the snow adhered, and thus provided a shield which effectively prevented the flakes finding their way around the root of the tail, where they would have soon melted and effectively chilled the thinly clad inner surface of the thighs. Provided with a caudal shield, long thick hair over the hind-quarters and back, and a thick mane covering both sides of the neck and protecting the small ears, a Celtic pony is practically snow-proof. While the storm lasted the pony in question stood perfectly still, with her head somewhat lowered, save when she shifted her position as the wind veered from north-west to north. Very different was the behaviour of an Arab, and a thoroughbred Highland colt close by. After trying various attitudes, the Arab, carrying her head low and to one side, made a rush for the shelter of an adjacent wood; the half-bred colt—prevented by her Celtic blood from running away—tried in vain one position after another, and long before the storm ceased looked thoroughly miserable and began to shiver as if chilled to the bone. It hence follows that the tail-lock is not, as I at first assumed, an inheritance from a primitive ancestor akin to the wild horse, but a highly specialised structure which eminently adapts the Celtic pony for a sub-Arctic environment. I need hardly say the caudal fringe is not a product of artificial selection, for even in Iceland, where it reaches its maximum development, neither its existence nor its use has, so far as I can gather, ever been referred to. It need only be added that to maintain a tail-lock of this kind it is necessary that the short wiry hairs of which it consists require to be renewed once a year.

In separating asses and zebras from horses, stress has hitherto been laid on the difference in the mane and tail, and especially on the absence of hind chestnuts. As already pointed out, the wild horse during summer in its mane and tail agrees with asses and zebras. The mane and tail are hence no longer of specific importance. This is also true of the chestnuts, for in the Celtic pony, as in asses and zebras, the hind chestnuts (hock callosities) are completely absent. In the wild horse, as in the vast majority of heavy and cross-bred horses, the hind chestnuts reach a considerable size, but in asses and zebras and the Celtic pony I have failed to find any rudiments of hind chestnuts either before or after birth. Further, in the Celtic pony the front chestnuts are small, and, still more remarkable, the fetlock

Photograph by G. A. Ewart.

FIG. 6.—Celtic pony, to show tail-lock in midwinter.

callosities (ergots) have entirely vanished; in asses and zebras the ergots are always present, and in some cases still play the part of pads. The Celtic pony is hence not only more specialised—further removed from the primitive type—in its mane and tail, but also in having lost the fetlock pads (ergots) and the hock (heel) callosities. Nature makes little effort to get rid of useless vestiges, so long as they are harmless. When an ergot or a chestnut is accidentally torn off there is considerable loss of blood. It is conceivable that in the remote past horses which happened to be born without ergots proved better adapted for a life in the sub-Arctic regions were less likely to suffer from injury when moving through frozen snow and to become a prey to wolves—and hence had a better chance of surviving and leaving descendants.[1]

There is also evidence of specialisation in the teeth of the Celtic pony. In many horses—*e.g.* the horses of south-eastern Asia the canines and upper first premolars (wolf teeth) are well developed, but in the Celtic pony the first premolars seem to be invariably absent, while the canines are either absent or very minute even in old males. In all the typical Celtic ponies I have seen the head is small, Arab-like in outline, and well put on to a relatively long neck; the muzzle is fine and slightly arched, the under lip short and well moulded, the nostrils are wide, and the eyes on a level with the forehead, while the ears are short, white-tipped, and carried as a rule in an upright position. Owing to the shortness of the jaws the proportion of the head to the body is as 1 to 2·50 instead of 1 to 2·20, as in the wild horse.

Except in size I have been unable to discover any difference between the skeleton and teeth of the Celtic pony and those of the small horse of the "elephant bed" of the Brighton Pleistocene. In the most northern part of Iceland, where the few pure specimens of the Celtic pony survive, only a height of 12 hands (48 inches) is reached—under more favourable conditions the height would probably be 50 or 52 inches, the size of some of the "elephant-bed" horses and of the smaller variety of the desert-bred Arab, to which the small slender-limbed occidental pony closely approximates.

In temperament the Celtic pony is very different from the wild horse. Captain Hayes had no difficulty in handling the wild horse in my possession, but from first to last, though giving evidence of marked intelligence, it was absolutely irresponsive and spiritless. A Celtic pony, on the other hand, rapidly learns what the trainer wishes and responds with alacrity. In its keenness and speed, staying power and agility, a pure Celtic pony is as different from an ordinary heavy-headed Iceland pony (*i.e.* a dwarf horse) as an Arab is from a cart-horse.

The question may now be asked, Is my most typical Celtic pony a pure or nearly pure specimen of a once widely distributed wild species, or is it at most an approximation to an ideal type, living representatives of which no longer exist? I regard the pony described above as an almost pure representative of a once widely distributed wild species, for the following reasons: (1) In its colour and markings it is almost identical with Prjevalsky's horse, and not unlike some of the varieties of the wild Asiatic ass. (2) The hind chestnuts and all four ergots are completely absent. (3) The tail-lock is perfectly adapted for its work—were the hairs shorter the fringe would be ineffective, were they longer the snow-shield, if ever formed, would rapidly disintegrate. (4) The first premolars are completely absent, and only one of the four canines is represented, and that only by a minute peg which barely projects beyond the gum. (5) The pony in question proved sterile with stallions belonging to five different breeds, as well as with a Burchell zebra and a kiang; but she at once bred when mated with a yellow-dun Connemara-Welsh pony, which closely approximates to the Celtic type. (6) Ponies having the more striking Celtic characteristics occur in isolated and outlying areas, where one would expect to find remnants of an ancient highly specialised species which perchance reached the Old World from the New in pre-Glacial times or during warm inter-Glacial periods in, *e.g.*, Iceland (which has been almost completely isolated since the twelfth or thirteenth century), the Færoe Islands, Shetland, the Hebrides, the west of Ireland, and Finland.

Flat-nosed Variety of the Celtic Pony. In the Færoes, the Hebrides, and in Shetland there are slender-limbed ponies which, except in their colour and the shape of the head, and in some cases the form of the hind-quarters, closely agree with my typical Celtic pony. In these ponies the depression below the eyes is more pronounced, and extends well-nigh to the muzzle, which is nearly flat. The nostrils look downwards, and the space between them, instead of being arched as in the Iceland specimen, is flat, and forms nearly a right angle with the face.

Some of these flat-nosed ponies are of a foxy-red colour, others are dark brown. According to Landt, the majority of the Færöe ponies a century ago were foxy-red—the St. Kilda ponies, eighteen in all, seen by Martin at the end of the seventeenth century, were also of a red colour—the others were with few exceptions dark. A foxy-red Færoe pony in my possession has neither a dorsal band nor bars on the leg, but it has a light mane and tail, a nearly straight croup, and well formed hind-quarters. All the other foxy-red Færöe ponies I have seen or heard of closely resemble the one in my collection.

The dark Færöe ponies, like the dark Barra ponies, only differ from the foxy-red ponies in not having in every case a straight croup and a high set-on tail, while the dark variety of the Celtic pony found in Shetland is in build more like the typical Iceland specimens than the Færöe variety.

Herodotus (*v.q.*) says of the horses of the Sigynna—the only tribe he knew the name of across the Danube—they "are shaggy all over the body, to five fingers in depth of hair: they are small, flat-nosed, and unable to carry men; but when yoked to chariots they are very fleet, therefore the natives drive chariots." This description, so far as it goes, is singularly accurate of the foxy-red Færöe ponies, even to their being very fleet "when yoked to chariots." It is extremely probable that in the red coloured Færöe ponies we have a remnant of a very old and once widely distributed variety, the origin of which is never likely to be revealed. For some unaccountable reason the silver mane and tail are as a rule either handed on untarnished to cross-bred offspring or they reappear in the second or one of the subsequent generations. It is hence possible that various large breeds—such as the Suffolk Punch, the white-maned horses of the Hebrides and of the north and west of Ireland, certain silver-maned Hungarian and Russian races, not to mention Chittabob and other English thoroughbreds—have all inherited their light manes and tails from an ancient foxy-red variety of the Celtic pony.

The origin of the dark brown variety of the Celtic pony is also wrapped in mystery. These dark brown ponies may represent another old variety from which the Exmoors have sprung—a variety which has contributed the tan-coloured muzzle and the ring round the eye so characteristic of many of the best Highland and Island garrons. One of these dark brown ponies, brought from Barra as a two-year-old, looked for a time like a miniature thoroughbred. Now as a three-year-old it might pass for one of the oldest and best type of the dark Færöe ponies. Neither the dark nor the red Færöe ponies ever possess all the Celtic characteristics; at the most they are three parts pure, and I may add they cross freely with Norwegian and other breeds, generally transmitting such Celtic "points" as they possess to their mixed offspring.[1] It is worthy of note that in some of the small-headed horses engraved in the Combarelles and other caves inhabited in Palæolithic times, the croup is straight and the tail set on high as in many Arabs; in others the tail, instead of being in a line with the croup, looks as if it had been an afterthought—an appendage inserted fairly well up in some cases, lower down in others, as is the case in many large and small horses with rounded quarters. In the engravings showing a small-headed horse with a straight croup we seem to have the foxy-red variety represented; in those with somewhat drooping quarters we may have a representation of the dark brown variety of the Celtic pony.

If one may judge from its specialisation and from its being now adapted for sub-Arctic conditions, the Celtic pony belongs to a variety which at a very remote period branched

[1] If, as seems likely, the absence of ergots (*i.e.* of spurs in the centre of the footlocks) is an advantage in arid regions, such as the Libyan plateau, we can understand their frequent absence in Barbs and Arabs.

[1] See Marsball and Aonandale, *Proc.* Cam. Phil. Soc, vol. xii. part iv.

off from the main stem and possibly reached Europe and North Africa long before the advent of the Neoliths—to become the progenitors not only of occidental but also of African races.[1]

As might have been anticipated, Celtic characters can often be identified in British and other occidental breeds. Many thoroughbreds, which are an unequal blend of Barbs and of Arabs in which Eastern races often prevail, and of light and heavy occidental varieties, show traces of Celtic ancestors. Many small thoroughbreds "ride like a pony," or have a pony head, or pony legs, some even want the ergots or hind chestnuts, or the tail has a vestige of a fringe, or there is the gait and temperament, alertness and intelligence of the pony. Many of the Highland garrons have pony characteristics, and this is also true of all the old mountain and moorland breeds, more especially of the mealy-nosed Exmoor ponies and some of the better bred dun-coloured Connemaras.

Even in Clydesdales of the older type pony characters sometimes surge to the surface, while in cross-bred animals they sometimes predominate. Recently I heard of a powerful active 17-hands horse—with a wonderful reputation for speed, strength, and staying power—in which the hind chestnuts, greatly to the surprise of the owner, were completely absent. On making inquiries as to the pedigree of this horse, I ascertained he was bred in Caithness, and was the grandson of a Highland pony.

The Norse Horse (*Equus caballus typicus*).

During prehistoric times in certain parts of Europe a tundra fauna gave place to a steppe fauna, which later was succeeded by a forest fauna. Evidence of this succession we especially have in the rock-shelter at Schweizersbild, near Schaffhausen. In the lower deposits the remains of the reindeer, musk-ox, variable hare, Arctic fox, and other tundra forms occurred. Nearer the surface were relics of hamsters, the woolly rhinoceros, kiang, horse, and other denizens of the steppes; and on still higher layers the bones of the beaver, hare, and squirrel, the badger, pine martin, and wild boar, the stag, roedeer, urus, horse, and other recognised members of a true forest fauna.

In the case of the Equidæ it is often extremely difficult to determine to which species any given bones belong, and hence it is impossible to state definitely that the horses found along with the hamsters and other steppe forms essentially differed from those which were contemporaries of the stag and wild boar and other typical forest forms.

It may, however, be assumed that even in post-Glacial times the majority of the inhabitants of the steppes would when mature be quite or nearly whole coloured, while frequenters of the forests would as often be either striped or spotted—that, *e.g.*, the horse which frequented the Rhine valley along with the kiang and woolly rhinoceros would resemble the wild horse (*E. c. prjevalskii*) which, with the kiang, now lives in the vicinity of the Great Altai Mountains, while the horse which at a subsequent period was a contemporary of the wild boar, stag, and roedeer would be more or less richly striped, and in its limbs and general conformation adapted for a life in or near forests.

That there is some ground for this assumption will, I think, be admitted when due consideration is given to results obtained by crossing various kinds of horses with a Burchell zebra. When ponies of the Celtic type—*i.e.* ponies which in their colour are identical with Prjevalsky's horse, almost certainly the lineal descendant of the steppe horse of Palæolithic times—are crossed with a male Burchell zebra, hybrids are obtained which, while in build strongly suggesting a Burchell zebra, are as profusely striped as the great zebra of Somaliland—have at least five times as many transverse stripes across the trunk as occur in their zebra sire. When, however, pony mares of the Norwegian type are crossed with a Burchell zebra, the hybrids resemble in make their Norse dams, and in their markings closely approximate the common or mountain zebra. The explanation of these remarkable differences seems to be that in the case of the Celtic pony hybrids the remote (Grévy-like) ancestors of the Burchell zebra control the development and determine the plan of the decoration, while in the case of the Norse pony hybrids the remote striped-horse ancestors contribute the more obvious characters—the Norse ponies having more influence in determining the plan of striping than the highly specialised Celtic ponies, from which stripes had probably all but completely disappeared countless generations before they began to fade on the horses which belonged to the forest fauna.

It is probable that the highly specialised Celtic pony, as well as the primitive Gobi wild horse, belong to the steppe fauna, and it is equally probable that the yellow-dun (Fjord) horse, in which a striped coat may be said to be latent, belongs to the forest fauna. If this be admitted, it follows that the environment of the Norse race has been for untold ages so different from that of the Celtic pony and the wild horse that it centuries ago acquired the rank of a distinct species, or at least a well marked natural variety.

The question now arises, Does there exist in any of the outlying parts of the world (where artificial selection has been made use of to conserve old rather than to create new types) horses of a red rather than of a yellow-dun colour—more like the red deer than the kiang—horses with a sufficient number of imperfect stripes on the body and bars on the legs to indicate descent from ancestors decorated after the manner of the mountain zebra? As is now generally known, dun-coloured horses with remnants of a striped coat now and again make their appearance in all parts of both the Old and New World. It is also a matter of common knowledge that dark yellow-dun horses, sometimes with fragments of numerous stripes, are always to be met with in, amongst other places, Mongolia, Tibet, the North-West Provinces of India (especially in the State of Kattiawar), and in the north-west of Europe, more especially in Norway, the Highlands and islands of Scotland, and in Iceland. With the exception of the Kattiawars, which, probably as the result of rigid selection, stand apart, all the others have many points in common—some of the dun Mongol ponies agreeing closely with Norwegians—but they all—the Kattiawars more than the rest—decidedly differ from *E. c. prjevalskii*, the wild horse of the Great Altai Mountains, and from typical specimens of the light yellow-dun Celtic pony.

The most richly striped horses I have hitherto come across occur in the north-west of Scotland. One of these recently examined is alike in make, colour, and markings so unique, and looks so little modified by domestication and artificial selection, that it must, I think, be considered as a fairly typical specimen of a once wild species. The history of the yellow-dun striped race, to which the specimen alluded to belongs, has not yet been written, but there is little doubt that it was introduced into Scotland from Scandinavia about the end of the eleventh or beginning of the twelfth century. As this yellow-dun striped race may very well have been familiar to Linnæus, it may, I think, be taken as the type of the large occidental breeds, and known as the *Equus caballus typicus*. A typical specimen of the Norse variety is of a dark yellow-dun colour, with black "points" and a nearly black mane and tail. The mane is long and heavy, and tends to fall to both sides of the neck as in the Celtic pony. Only a few hairs at the root of the tail are shed in summer, and there is no attempt to form a tail-lock in winter, while the footlocks, never very long, are limited to the region of the ergots. The forehead is decorated with narrow stripes, which in their number and arrangement agree more with the mountain than with the true Burchell zebra. A broad dorsal band extends along the back to lose itself in the tail; there are stripes on the neck, and faint stripes extend a short distance from the dorsal band across the body, as in the British Museum quagga; while the legs, especially in the region of the "knees" and hocks, are marked by distinct bars.

The ears are short and are carried in a nearly upright position; the forehead (which is not particularly wide), in having two ridges extending upwards from the prominent

[1] That the Celtic pony is akin to the smaller high-caste Arabs has already been hinted. The only fundamental difference, apart from the coat, mane, and tail, between many small Arabs and a Celtic pony is in the ears: in the Arab they are long and often incurved at the points. The long ears of the Arab may either be due to Eastern blood of the Kattiawar kind or to long ears being an advantage to the wild ancestors that frequented the great Libyan plateau, as long ears are of advantage to the mountain zebra, and to the kangaroo of the Australian bush. About the origin of the large varieties of Arabs provided with ergots, with hind chestnuts like those of Prjevalsky's horse, a somewhat long head, a tendency to a Roman nose, large joints, and a circumference of 7½ to 8 inches below the knee, I am unable to offer an opinion.

eyes to meet under the forelock, differs greatly from the "bumpy" forehead of Prjevalsky's horse and the flat forehead of the Celtic pony. The space between the orbit and the nostril is relatively longer than in the Celtic pony, but shorter than in Prjevalsky's horse. The eyes project beyond the level of the forehead. In the Celtic pony the eyes are large and adapted for a wide range, in the wild horse they are some distance from the front of the head, in the Norse horse they are small and look downwards rather than forwards. The outline of the face becomes convex above the muzzle, and ends in a somewhat long upper lip, adapted, like the upper lip in the giraffe, for feeding on leaves and twigs. In the neck and shoulders, trunk and limbs, the Norse variety may be said to resemble a small cart-horse of the Suffolk type.

Compared with the wild horse, the withers are lower and the hind-quarters more rounded, and the tail springs more abruptly and at a lower level, and hence fails to convey the impression that it is a direct continuation of the trunk. The dock is relatively longer than in the Celtic pony, but shorter than in the wild horse. The limbs are short, but the joints are large and the hoofs fairly broad, hence in a side view of the foreleg a considerable increase is noticed as the thick fetlock joint is reached.

It will be evident from what has been said that the Norse horse differs chiefly from the wild Gobi horse in being of a darker dun colour, in being far more richly striped, in the shape of the head, size of the ears, position of the eyes, and also in the muzzle, mane, tail, hind-quarters, joints, and hoofs. From the Celtic pony the Norse horse also differs in the colour and markings; but it especially differs in the tail and in the greater proportional length of the distance between the eye and the nostril, and in having a complete set of ergots and chestnuts. It is inconceivable that the Norse variety could revert to the Prjevalsky horse type, or be regarded as an offshoot from the Celtic pony.

The question may now be asked, Is there any evidence that the Palæoliths of the south of Europe were familiar with horses of the Norse type? Fig. 7 gives an imperfect idea of a specimen of the Norse race from the west of Ross-shire. If this figure of a horse still living is compared with Fig. 2, which faithfully reproduces an engraving made thousands of years ago in the Combarelles cave by one of the artist-hunters of the Early Stone age, it will, I think, be admitted the Norse horse probably belongs to a very ancient race.

Photograph by G. A. Ewart.

Fig. 7.—A richly striped dark yellow-dun horse of the Norse type, which has a general resemblance to the Combarelles horse reproduced in Fig. 2.

I need only add that I regard the Norse race as the foundation of what in the Highlands are known as garrons. Horses of this type may very well have been originally obtained by blending the old indigenous yellow-dun striped race with Flemish and French breeds imported direct from the Continent or introduced from England during the middle ages. Further, it is extremely probable that the Norse race took part in forming the small active Clydesdales of a former generation.

Other Occidental Horses.

In addition to oriental and African varieties, which doubtless include several wild species amongst their ancestors, there are two or more occidental varieties which in various ways differ from the Norse and Celtic races and from Prjevalsky's horse.

One of the latter races include long, low, heavily built animals with unusually long heads, another consists of short-bodied animals with a large head and a pronounced Roman nose.

The long-headed variety which occurs in the Hebrides and the Central Highlands reminds one of the horses engraved during the Stone age on a piece of reindeer horn. In one specimen of this variety met with in Perthshire the profile is straight and the distance from the orbit to the nostril is 13 inches, *i.e.* 2 inches more than in a member of the Norse breed of a like size, and 4 inches longer than in a 14 hands Connemara pony allied to the Celtic race. Some of these long-headed forms with a straight profile and a well moulded muzzle resemble the horses of the Parthenon.

Horses with a pronounced Roman nose also occur in the western islands and Highlands of Scotland, and in Ireland, Austria, America, and other parts of the world into which breeds were introduced from Spain. One of this Roman-nosed type, of a yellow-dun colour, met with in the Outer Hebrides was especially interesting. It very decidedly differed from members of the Norse race in the same district, but, on the other hand, it agreed in the outline of the head with some of the engravings in the Dordogne caves. It is hence conceivable that the Roman-nosed variety (from which the modern Shire breed may be an offshoot) is a very old one—a variety which was firmly established centuries before domesticated breeds first made their appearance in Europe.

Summary.

I have endeavoured to indicate that in post-Glacial as in pre-Glacial times there were several distinct species of horses, and that it is extremely probable some of the prehistoric species and varieties have persisted almost unaltered to the present day. I have shortly described three distinct kinds of living horses, viz. the wild horse of the Gobi desert (*E. c. prjevalskii*); the Celtic pony, which though no longer wild, may be known as the *E. c. celticus*; and the Norse horse, which may very well stand as the type of one of the large occidental breeds, and be known as *E. c. typicus*. I have also pointed out that in addition to these three very distinct types—two at least of which have taken part in forming quite a number of our British breeds—we have a long-headed, heavily built variety with a straight profile, and a long-headed, heavily built variety with a more or less pronounced Roman nose. I have also indicated that in addition to several occidental varieties there are several African and oriental varieties, and I might have added that, in so far as the English thoroughbred is a mixture of African and oriental varieties and of occidental light and heavy varieties, it might be cited as an excellent example of a breed which includes amongst its ancestors several wild species—a breed which has had a multiple origin.

ATMOSPHERIC TIDES.

An article on atmospheric tides, by Mr. W. Krebs, who is a frequent contributor to the scientific literature of Germany, appears in *Das Weltall*, a Berlin journal of astronomy, of December, 1903. The author points out that the astronomer Mädler demonstrated in 1837 from the Berlin barometer observations the existence of an oscillation of air pressure in the course of a lunar day. The mean range exhibited a minimum pressure in the afternoon and a maximum in the forenoon of that period. This occurrence, which was found by Mädler for the years 1820–1835, was confirmed by Prof. Börnstein with reference to the years 1884–1888, and was also shown to obtain at other German stations. But neither of these physicists ventured to affirm the existence of a tidal movement of the atmosphere in the oscillation which they had discovered.

The hitherto purely statical conception of the oscillations of air-pressure was an obstacle to such a theory. This conception supposed a maximum of pressure to be simply the result of an elevation, and a minimum to be the result of a depression of the barometric column. According to this still prevalent idea, a maximum of pressure must be expected at the time of the upper culmination, and a minimum at the time of the lower culmination of the moon. The former was, however, found to occur at Berlin almost exactly five lunar hours after the upper culmination, and the latter about the same time after the lower culmination. For these reasons Mädler thought it possible "that there was a third way in which the celestial bodies acted upon each other, which was still unknown to us," that is to say, other than by radiation and gravitation.

But the atmospheric oscillation in the course of a lunar day, first discovered by Mädler, appears to be nothing more than a wave caused by gravitation, when it is considered as a transverse oscillation and explained dynamically. The greatest rarefaction of the air occurs about half-way after the lower culmination, corresponding to the greatest uprising movement of the medium. The greatest compression of the air occurs about half-way after the upper culmination, corresponding to the greatest downward movement of the medium. In both cases an attraction of the moon on the lower atmosphere of the earth is presupposed. The third kind of mutual action between the celestial bodies assumed by Mädler accordingly reveals itself, in the case in question, as simply gravitation, when its effect is only considered from the standpoint of the wave theory. When applied to the solar day, the author considers that this view of the matter completes a missing link in the explanation of the double atmospheric oscillation according to Kelvin and Hann.

ON LEAD POISONING AND WATER SUPPLIES.

The second volume on the above subject has recently been issued by the medical officer of the Local Government Board. The former volume contained information concerning Dr. Houston's study of waters derived from moorland gathering grounds in Lancashire and Yorkshire; the present volume gives details of an extensive series of laboratory experiments bearing on the general subject and conducted by Dr. Houston. They have been published in order to facilitate the interpretation of the results obtained when studying the solvent or erosive power of a water on lead pipes, with the view of counteracting these dangerous qualities. Particular attention is directed to observations on "standards" (p. 443) in this volume, where methods of measuring the solvent and erosive powers of a water upon lead are given enabling an opinion to be formed as to the degree of risk arising from the contact of such water with lead surfaces.

The report is illustrated with drawings of the apparatus employed in the investigations, and photographs have been reproduced to show the actual amount of deposit remaining in the tubes in which the erosion of lead by water had been allowed to take place.

From the nature of this report it will be understood that the substance of it consists of the tabulated results, together with brief descriptions of the experimental methods adopted. The main conclusions arrived at were stated in the previous volume, but a general summary of all conclusions is also given in Section iv. of this volume. A reference to this summary will be found useful to those who are concerned with the consideration of dangers of lead poisoning arising from water supplies.

The summary starts with an explanation of the meaning of the term "erosion," and proceeds to state that bright lead is rapidly eroded by rain and by snow water, as well as by distilled water; then follow the names of substances which do not influence the erosive power of water when introduced into it, as well as of substances which delay and inhibit the action. Moorland waters are next considered in regard to their erosive property, and the conditions which increase, diminish, or prevent their erosion are stated. Then follow waters which do not fall under the above classification, together with remedial measures which may be adopted to avoid danger. A similar classification and consideration of waters as regards plumbo-solvency is then shortly entered into, and, finally, the conclusions arrived at from chemical and bacteriological experiments as to the cause of acidity in moorland water are given. The summary terminates with a selection of conclusions which have already appeared in the former volume.

F. C.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

Dr. H. H. Dixon has been elected professor of botany at Trinity College, Dublin, in succession to Dr. E. Percival Wright, who has resigned.

The Princess of Wales opened the new buildings of the St. Paul's Girls' School at Brook Green, London, W., on April 15. Accommodation is provided for a museum, chemical laboratory, and practical physics.

At the request of the Board of Treasury the following gentlemen have consented to act as a committee to consider the allocation of the proposed increased grant to the university colleges giving education of a university standard in arts and science, viz. the Right Hon. R. B. Haldane, M.P. (chairman), Sir F. Mowatt, G.C.B., I.S.O., Mr. C. A. Cripps, K.C., M.P., the Rev. Dr. Woods, late president of Trinity College, Oxford. Mr. Henry Higgs, of the Treasury, will act as secretary.

An annual commemoration day was inaugurated at the University of Glasgow on Tuesday. Sir William Ramsay gave a discourse on Joseph Black's life and scientific work; and after the oration several honorary degrees were conferred. At the commemoration banquet on Tuesday evening Mr. Choate, the United States Ambassador, remarked in the course of a speech that the universities had to do their best for the guidance of the councils of the nations to which they belonged.

The council for the extension of higher education in North Staffordshire has issued its report for 1903. The objects of the council are to stimulate interest in higher education throughout the district, to assist in coordinating institutions and classes for higher and technical instruction, to aid existing institutions by the provision of supplementary and advanced courses of instruction, and to take steps for the establishment of a suitable institution in which to conduct a scheme of higher education for the benefit of the whole district. The report gives, among other information, reasons for the establishment as soon as possible of the proposed North Staffordshire University College, and urges the members of the council to join in the promotion of the scheme.

The United States consul at Leipzig has, says *Science*, compiled a table of the number of students attending twenty-one German universities during the winter 1903–4. The total number of matriculated students at these universities is 37,854, of whom 3093 are foreigners, the largest number ever recorded. The number of foreign students is equivalent to 8·2 per cent. of the total number. Of other students attending lectures in these universities there are 7874 men and 1313 women, so that the total number of students is 47,041. Noteworthy among other things in the

table is the numerical preeminence of attendance at Berlin, where the total exceeds that of Munich, Leipzig, Bonn and Breslau combined. But 42 per cent. of Berlin's attendance is made up of non-matriculated students, representing a floating element to a considerable extent. Elsewhere in Germany this feature is a minor one in university attendance.

In his presidential address at the annual conference of the National Association of Manual Training Teachers, held at Hastings on April 5, Sir John Cockburn dealt with the psychological importance of manual training. It is now recognised, said Sir John Cockburn, that the hand is one of the best channels to the intelligence, and that in training the hand we minister most effectually to the requirements of intellectual, moral, and physical development. Time in giving intellectual studies would be saved if half the school hours were spent in the workshop. Pupils detect their errors in actual work more readily than in abstract processes, and learn to despise inaccuracy and slovenliness. Nothing so clearly demonstrates the difference between right and wrong as manual training. A lie in wood stands self-exposed. The constructive imagination is strengthened, and invention is stimulated by manual work. Psychologists are agreed that in developing the mind manual training must rank as an indispensable element in all primary and secondary schools.

To celebrate the seventieth birthday of President Eliot, president of Harvard University, the graduates and students of the university have subscribed a thousand pounds for a portrait or bust to be placed in the Union. A very eulogistic letter with ten thousand signatures was presented to President Eliot on his birthday. After enumerating the distinguishing characteristics of his thirty-five years of presidency, the letter continues :—"Through you the American people have begun to see that a university is not a cloister for the recluse, but an expression of all that is best in the nation's thought and character. From Harvard University men go into every part of our national life. To Harvard University come from the common schools, through paths that have been broadened by your work, the youth who have the capacity and the will to profit by her teaching. Your influence is felt in the councils of the teachers and in the education of the youngest child. . . . Fearless, just, and wise, of deep and simple faith, serene in affliction, self-restrained in success, unsuspected by any man of self interest, you command the admiration of all men and the gratitude and loyalty of the sons of Harvard." British men of science will join in the congratulations to President Eliot that he has passed the age of seventy with undiminished power.

At the ordinary meeting of the Society of Arts on April 13, Mr. J. C. Medd read a paper on agricultural education. He said it has now been realised that success in farming demands extensive scientific knowledge quite as much as thorough practical training. The development in the facilities for instruction since 1888 has been remarkable. Figures were quoted to show there had been a total outlay by the Government and by local authorities of nearly 100,000*l.* per annum. Mr. Medd thinks that it is to the evening school that the authorities must look for the improvement of the labourer and the recovery of the skilled or "handy" man. The paper concluded with a scheme to coordinate and place upon a satisfactory basis the rural and agricultural education of every county. Small village schools should be closed and their children conveyed daily to some central school. Better buildings and equipment, more regular attendance, and a more efficient staff would thus be ensured. A few favourably situated schools should be developed upon the model of the *écoles primaires supérieures*. A continuation school should be organised in every village. Winter schools of agriculture and horticulture should be established in selected districts according to the particular requirements and characteristics of each county, and the services of their directors should be made available for all farmers and gardeners during the summer. Demonstration plots should be placed in the charge of men who combined scientific accuracy with some actual knowledge of practical farming, and were in touch with the farmers of the district.

SOCIETIES AND ACADEMIES.

London.

Royal Society, March 17.—"Physical Constants at Low Temperatures. (1) The Densities of Solid Oxygen, Nitrogen, Hydrogen, &c." By Prof. James **Dewar**, M.A., LL.D., D.Sc., F.R.S.

The observed densities of solid oxygen and nitrogen, taken at the boiling point of hydrogen, are 1·425 and 1·026 respectively. Similarly the density of solid hydrogen between 13° and 14° absolute was found to be 0·076. From the observations given in the paper, the "Matthias Diameter Line" is deduced in each case, and from these the critical density and molecular volume at the zero of temperature follow. The molecular volume at zero of oxygen is 21·2, of nitrogen 25·5, and of hydrogen 24·2. From these results it follows that if solid water could result from a combination of solid hydrogen and oxygen taking place at the zero of temperature the reaction would involve a volume contraction of 45 per cent. A discussion follows of the critical constants of hydrogen in which the want of agreement between theory and experiment is pointed out. The conclusion reached is that in the case of the constants of hydrogen a marked variation from what in the case of other substances may be regarded as fairly general results must be anticipated, and that further experiments are required to clear up the difficulties.

Linnean Society, April 7.—Prof. S. H. Vines, F.R.S., president, in the chair.—Mr. E. P. **Stebbing** exhibited lantern-slides of the metamorphoses of *Clania Crameri*, a Psychid moth from the Madras Presidency, showing its use of its food-plant, *Casuarina equisetifolia*, in the making of its protective case. Mr. F. **Enock** displayed a series of more than fifty slides of natural colour photography of living insects and flowers by the Sanger-Shepherd three-colour process, the president adding a few remarks on the results. Mr. C. E. **Jones** then gave an abstract of his paper, the morphology and anatomy of the stem of the genus Lycopodium.

Faraday Society, April 13.—Mr. J. Swinburne, vice-president, in the chair.—Alloys of copper and arsenic: Arthur J. **Hiorns.** The object of the author's investigations was to ascertain the exact relation between copper and arsenic in binary alloys, and the limit of proportion of arsenic that can be retained in copper in the cold solid state. The addition of arsenic lowers the melting point of copper uniformly down to about 14 per cent., when a steep fall in the freezing point curve occurs, reaching its lowest point at 685° C. This alloy contains 19·2 per cent. of arsenic, which corresponds to the formula Cu_5As_2. The alloy with 22 per cent. of arsenic freezes at 708°, and the temperature gradually rises until the alloy with 28·34 is reached at 747°. This is the compound Cu_3As. At 810° another chemical compound freezes, having the chemical formula Cu_4As_2; it contains 32·2 per cent. of arsenic. Beyond this point the temperature gradually falls again to a minimum at the alloy with about 35 per cent. of arsenic. The curve then rises to another summit at 740°, forming the compound Cu_2As, with 37·24 per cent. of arsenic. From this position the curve descends to 702° with the alloy containing 41 per cent. of arsenic; this is nearly the practical limit of the direct combination of copper and arsenic.—Experiments with a new primary cell: E. G. P. **Bousfield.** The cell consists of an inner porous pot containing nitric acid and a carbon pole, and an outer vessel containing sodium hydrate solution and a metal pole, preferably zinc, *i.e.* with a solution of from 12 per cent. to 15 per cent.; using solutions of maximum conductivity with zinc and carbon poles on open circuit, an E.M.F. of 2·6 volts may be obtained. Not only does the cell possess this comparatively high E.M.F., but it may be short-circuited far longer than most cells before it runs down. A cell short-circuited through a total resistance of 0·61 ohm gave a current of 4·18 amperes, which fell to 2·61 in an hour, 2·38 in $2\frac{1}{4}$ hours, and 1·75 in 6 hours. A smaller cell gave a fairly constant current of about 0·8 ampere for 20 or 25 hours. Discharge curves are given in the paper.—Mr. **Bousfield** also contributed a note on determining accurately the percentage of ozone in gases not dissociated by moderate heat.

Mathematical Society, April 14.—Dr. E. W. Hobson, vice-president, in the chair.—Mr. G. B. Mathews communicated a paper by Prof. F. **Morley** on a plane quintic curve. The curve is the locus of the points of contact of tangents from a fixed point to a pencil of cubics. It is of maximum genus (deficiency), viz. 6, and the 45 tangents at points of inflexion pass by nines through 5 points.—Mr. H. M. **Macdonald** gave an account of his recent researches concerning the singularities of functions determined by Taylor's series. Unless special relations hold among the coefficients of the series every point on the circle of convergence is a singularity, and attention has been directed to the problem of determining the coefficients in order that the function may have singularities at prescribed points on the circle only.—The following papers also were communicated:—Note on a system of linear congruences: Rev. J. **Cullen.**—The tile theorem: Dr. W. H. **Young.**—Note in addition to a former paper on conditionally convergent multiple series: G. H. **Hardy.**—On functions generated by linear difference equations of the first order: Rev. E. W. **Barnes.** The simplest solutions of linear difference equations with meromorphic functional coefficients are one-valued functions with sequences of poles tending to infinity. When the coefficients are one-valued functions with essential singularities the solutions generally have sequences of such singularities. These functions cannot in general arise as the integrals of differential equations of any finite order and dimensions with coefficients which are not derived from the function itself. Thus linear difference equations give rise to classes of transcendental functions which cannot be generated by differential equations.—Mathematical analysis of wave-propagation in isotropic space of p dimensions: T. H. **Havelock.** In the case of three dimensions certain methods of integration of the equation of wave-propagation were found by Poisson and Kirchhoff. These are connected with the analytic expression of Huygens's principle. In two dimensions the corresponding integrals are more complicated, and the interpretation of them shows that in general the waves generated at a temporary source have no definite rear surface, but leave a trail behind. Corresponding integrals are obtained in the paper in the case of any number of dimensions, and it is shown that this distinction of properties extends to all cases of uneven and even numbers of dimensions.—On spherical curves, part ii.: H. **Hilton.**—Perpetuant syzygies of degree four: P. W. **Wood.**—Extension of Sylow's theorem: Prof. G. A. **Miller.**—(1) Transformation of the function $F([\alpha][\beta][\gamma]x)$; (2) The extension of Neumann's addition theorem for Bessel functions: Rev. F. H. **Jackson.**—The following informal communications were made:—Behaviour of a power series near a point on the circle of convergence at which the series diverges: Dr. H. F. **Baker.**—Transvectant operators in connection with binary forms: R. J. **Dallas.**—Factorisation of $13^{39}-1$: Lieut.-Colonel A. **Cunningham.** The factors are 4.3; 3.61; 1803647: 53.264031; 5774512466268l*: 79.1093.4603.21841, where the semicolons separate the algebraic factors and the colons separate the Aurifeuillian factors. The factor marked with an asterisk has not been resolved.

Manchester.

Literary and Philosophical Society, January 5.—Prof. W. Boyd Dawkins, F.R.S., president, in the chair.—Note on a method of preparing hydrobromic acid: R. L. **Taylor.**

January 19.—Prof. W. Boyd Dawkins, F.R.S., president, in the chair.—The specific heats and specific volumes of certain alloys: H. E. **Schmitz.** The calculated and observed values in the cases examined agreed very closely.—On phenomena due to repetitions of stress, and on a new testing machine: F. **Foster.** When a metal is strained by a steady stress, the crystals of which it is composed undergo no change until the elastic limit is passed, but then an internal slipping takes place, which is permanent. The same slipping takes place if a stress much less than the elastic limit is applied and removed repeatedly, and is due probably to hysteresis in the extension of the metal. In order further to study these phenomena, the author has designed a new testing machine capable of subjecting the metal under test to a great variety of conditions.

February 2.—Prof. W. Boyd Dawkins, F.R.S., president, in the chair.—A diagnostic key for the genera of recent dibranchiate Cephalopoda: Dr. **Hoyle.**

February 16.—Mr. Charles Bailey in the chair.—On a suitable arrangement for determining the capacities of condensers by the successive discharge method: H. **Morris-Airey** and E. D. **Spencer.** The rotating commutator generally employed in this method was replaced by an electrically excited tuning fork, the prongs of which carried aluminium riders making contact in mercury cups. By this means it was possible to obtain perfectly regular discharges at a much bigger rate than is usually possible with rotating commutators.—Note on the spectrum of the glow discharge at atmospheric pressure: Dr. G. A. **Hemsalech.** With an alternating discharge the spark spectrum between metallic terminals is affected by heating them, the glow then being obtainable at either pole.

Special Meeting, February 23.—Prof. W. Boyd Dawkins, F.R.S., president, in the chair.—The Wilde lecture, on the evolution of matter as revealed by the radio-active elements, was delivered by Mr. F. Soddy (see p. 418).

March 1.—Prof. H. B. Dixon, F.R.S., in the chair.—The ionisation of air: Prof. A. **Schuster,** F.R.S. The author described a method of observation which allowed him to determine the number of ions which are constantly being formed in the atmosphere. All experiments which have hitherto been made only determined the total number of ions present, but not the rate at which they re-combined or formed. Some experiments made in a field near Rochdale on February 28 gave 2400 for the number of ions in each cubic centimetre of air, and a formation of 18 new ones in each second, while on the roof of the physical laboratory at the Owens College on February 29 the numbers were 3600, with a formation of 38 fresh ones each second.

March 15.—Prof. W. Boyd Dawkins, F.R.S., president, in the chair.—The Falkland Islands revisited: Rupert **Vallentin.** The principal zoological, botanical and geological features of the district were described.—Mendel's principles of heredity: A. D. **Darbishire.**—On photochemically active chlorine: D. L. **Chapman.**

Paris.

Academy of Sciences, April 11.—M. Mascart in the chair.—Theory of the quadrifilar azimuth balance: H. **Poincaré.** An investigation of the equations of sensibility and stability of the quadrifilar balance described by M. Crémieu.—Note on the graphical method applied to human pathology: M. **Lannelongue.** The graphical method, the use of which is described in detail in the paper, can be applied with advantage in a number of cases where photography or radiography would not give the same results.—A new general theorem in the theory of analytical functions: G. **Mittag-Leffler.**—Remarks on the communications of M. A. Charpentier, and the questions of priority to which they have given rise: M. **d'Arsonval.** The results of Charpentier are held to be new, since it is one of the characteristics of the radiations which he has discovered that they are without effect on a photographic plate, whilst the work of others claiming priority in this matter has been mostly carried out by means of photography.—On a particular class of persistent conjugate systems: D. Th. **Egorov.**—On groups of operations: G. A. **Miller.**—On the equations of geometry and the theory of substitutions: Ed. **Maillet.**—A quadrifilar azimuth balance: V. **Crémieu.** A description of an entirely new form of balance, in which the beam is supported by a plunger floating in mercury, and in which the pointer of the ordinary balance is replaced by a system supported by four wires in torsion attached to the beam. The theory of this balance is worked out by M. Poincaré in a previous paper. Instead of using a rider, differences below a centigram are measured by means of the electrodynamic repulsion produced between two bobbins, the current being adjusted by means of a resistance until the point of equilibrium is reached.—On the penetrating power of the n_1-rays emitted by certain sources, and their storage by different substances: Julien **Meyer.** The n_1-rays, discovered by Blondlot, the effects of which are the inverse of the n-rays, are given off by vacuous glass tubes, and possess a greater penetrating power than the similar rays given off by a Nernst lamp. Certain substances appear to possess the power of storing up these rays, aluminium being a notable example, and then emit them for as long as twenty-four hours afterwards.—On the earth-

quake in the Balkans, April 4: Th. **Moureaux.**—Electrical osmosis in methyl alcohol: A. **Baudouin.** The method adopted by M. Perrin in studying electrical osmosis in aqueous solutions has been applied by the author to solutions in methyl alcohol. The effects observed are similar to the case of water, but smaller in magnitude, so that higher differences of potential had to be employed. Osmosis is very sensitive to traces of dissolved materials provided that these are electrolytes. Non-electrolytes, even in comparatively large proportions, are without effect.—On the calculation of the heats of combustion of organic compounds containing nitrogen: P. **Lemoult.** A general formula for calculating the heat of combustion of any compound containing carbon, hydrogen, oxygen, and nitrogen is worked out, and numerous examples are given of the degree of approximation obtained.—On the application of the Blondlot rays to chemistry: Albert **Colson.** By means of the effects on a phosphorescent screen the author has been able to detect differences in the interaction of solutions of potash and zinc sulphate according to the order in which they are mixed, and these differences have been subsequently borne out by their chemical behaviour.—On a new mode of formation of calcium carbide: L. M. **Bullier.** Calcium carbide can be obtained by the electrolysis of a mixture of calcium chloride and lime, but the method has no commercial value. —The estimation of nitrogen: Léon **Débourdeaux.** Methods of estimating nitrogen based on the production of ammonia are all liable to be vitiated by the production of amines, notably methylamine. The method now described, which is based on the dry distillation of the nitrogen compound with a mixture of potassium monosulphide and potassium thiosulphate, gives ammonia free from amines. A list is given of the classes of compounds to which this method is applicable.—The influence of hydriodic acid on the oxidation of sulphurous acid: A. **Berg.** Hydriodic acid may either retard or accelerate the oxidation of sulphurous acid according to its concentration. For a given strength of sulphurous acid, there appears to exist a strength of hydriodic acid which is without influence on the rate of oxidation. Other substances besides hydriodic acid can affect the rate of oxidation.—The chlorination of phenyl carbonate in the presence of iodine: Et. **Barral.**—The action of oxidising agents on the purity of industrial fermentations: Henri **Alliot** and Gilbert **Gimel.** Various oxidising agents were tried with a view to see which exerted the greatest effect in reducing the production of butyric acid during an alcoholic fermentation. Manganese dioxide and bleaching powder gave the best results.—On *Randia Lujae*, a new myrmecophyte and acarophyte of the family Rubiaceæ: E. **de Wildeman.**—On the sense of rotation of water eddies in central Europe: Jean **Brunhes.** In more than 90 per cent. of the vortices observed in the small rapids of central Europe, the sense of rotation was always opposite to that of the hands of a watch.—New researches on the statical work of a muscle: Charles **Henry.**—The specific reinforcement of phosphorescence by extracts of organs in physiological exploration: Augustin **Charpentier.**—Biological observations made at Chamonix and on Mt. Blanc during August and September, 1903: Raoul **Bayeux.** The quantity of oxyhæmoglobin increases in normal blood with the altitude, but, on the contrary, the speed of reduction of the oxyhæmoglobin diminishes with increasing altitude. —The amounts of catalase in different animal tissues: F. **Battelli** and Mlle. L. **Stern.**—On the origin of lactose: Ch. **Porcher.**—The agglutination and hæmolysis of the blood corpuscles by chemical precipitates: M. **Gengou.**—On the yellow spot disease of the cork oak: F. **Bordas.**

DIARY OF SOCIETIES.

THURSDAY, APRIL 21.

ROYAL INSTITUTION, at 5.—Dissociation: Prof. Dewar, F.R.S.

LINNEAN SOCIETY, at 8.—On British Freshwater Rhizopoda: J. Cash.—*Exhibitions*: Drawings by Mrs. C. Reid of Fruits and Seeds of British pre-Glacial and inter-Glacial Plants II. Calycifloræ: Clement Reid, F.R.S.—Holograph Letter of Linnæus to Haller, dated from Upsala, May 12, 1747: R. Morton Middleton.

INSTITUTION OF CIVIL ENGINEERS, at 8.—"James Forrest" Lecture: Internal Combustion Engines: Dugald Clerk.

INSTITUTION OF MINING AND METALLURGY, at 8.—Adjourned discussion on the Equipment of Laboratories for Advanced Teaching and Research in the Mineral Industries.

FRIDAY, APRIL 22.

ROYAL INSTITUTION, at 9.—Sleeping Sickness in Uganda: Colonel David Bruce, F.R.S.

PHYSICAL SOCIETY, at 5.—Calculation of Colours for Colour Sensetometers and the Illumination of "Three Colour" Photographic Transparencies by Spectrum Colours: Sir W. de W. Abney, F.R.S.—On Normal Pileing as connected with Osborne Reynolds's Theory of the Universe: Prof. J. D. Everett, F.R.S.—Note on the Diffraction Theory of the Microscope as applied to the Case when the Object is in Motion: Dr. R. T. Glazebrook, F.R.S.

INSTITUTION OF CIVIL ENGINEERS, at 8.—No 2 River-pier of the Beckton Gasworks: A. Trewby.

MONDAY, APRIL 25.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—The German Antarctic Expedition: Dr. Eric von Drygalski.

VICTORIA INSTITUTE, at 4.30.—Old Testament Chronology: F. G. Fleay.

INSTITUTE OF ACTUARIES, at 5.—On Life Premium Book-keeping: J. Chatham.

TUESDAY, APRIL 26.

ROYAL INSTITUTION, at 5.—The Transformation of Animals: Prof. L. C. Miall, F.R.S.

ANTHROPOLOGICAL INSTITUTE, at 8.15.—The Origin of Jewellery: Prof. W. Ridgeway.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Annual General Meeting.

WEDNESDAY, APRIL 27.

SOCIETY OF ARTS, at 8.—The Need of Duty-Free Spirit: Thomas Tyrer.

GEOLOGICAL SOCIETY, at 8.—On a New Species of Eoscorpius from the Upper Carboniferous Rocks of Lancashire: W. Baldin and W. H. Sutcliffe.—The Genesis of the Gold-Deposits of Barkerville (British Columbia) and the Vicinity: A. J. R. Atkin.

THURSDAY, APRIL 28.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: Further Experiments on the Production of Helium from Radium: Sir William Ramsay, K.C.B., F.R.S., and Frederick Soddy.—The Effects of Changes of Temperature on the Modulus of Torsional Rigidity of Metal Wires: Dr. F. Horton. —The Sparking Distance between Electrically Charged Surfaces. Preliminary Note: Dr. P. E. Shaw.—Studies on Enzyme Action. Part II. The Rate of Change Conditioned by Sucroclastic Enzymes, and its Bearing on the Law of Mass Action. Part III. The Influence of the Products of Change on the Rate of Change Conditioned by Sucroclastic Enzymes: Dr. E. F. Armstrong.—Part IV. The Sucroclastic Action of Acids as Contrasted with that of Enzymes: Dr. E. F. Armstrong and R. J. Caldwell.—Enzyme Action as bearing on the Validity of the Ionic-dissociation Hypothesis, and on the Phenomena of Vital Change: Prof. H. E. Armstrong, F.R.S.—On the Changes of Thermoelectric Power produced by Magnetisation, and their Relation to Magnetic Strains: Dr. Shelford Bidwell, F.R.S.—The Behaviour of the Short-period Atmospheric Pressure Variation over the Earth's Surface: Sir Norman Lockyer, K.C.B., F.R.S., and Dr. W. J. S. Lockyer.

CONTENTS.

THURSDAY, APRIL 28, 1904.

HETERŒCIOUS RUST-FUNGI.

Die Wirtswechselnden Rost-pilze. By H. Klebahn. Pp. 426 + preface, appendix, bibliography, and two indexes. (Berlin: Bornträger, 1904.) Price 20 marks.

IN 1864–65 De Bary startled the biological world with his discovery of the heterœcism of the Uredineæ—with his proofs that the long suspected and often re-iterated connection between the peculiar yellow fungus known as Æcidium, growing on the barberry, and the well-known rust-fungus, Puccinia, which devastates wheat and other cereals, is true in fact, and that the winter-spores of the latter germinate in spring and develop spores which infect the young barberry leaves, whereon are then developed the quite different spores of the Æcidium, which in their turn re-infect the wheat.

Investigations along the same experimental lines, and supported by the same irresistible logic, soon showed that many other Uredineæ, or rust-fungi, are capable of a similar change of life as they pass from one host-plant to another, among which were the Gymnosporangia of junipers, which develop the very different Rœstelia on Pomaceæ (hawthorns, pears, &c.), and the even more remarkable cases of Coleosporium on Senecio, which infects pines and develops thereon the curious æcidial forms known as pine blisters, or Peridermium.

The list of heterœcious Uredineæ, or rust-fungi, which thus change their hosts and develop a different kind of fungus on each host now numbers 160, including a few cases only where the phenomenon is not yet proved with absolute certainty by the experimental infections, and Klebahn has set himself the task of bringing together all the salient biological features of these remarkable plants, the economic importance of which to mankind is sufficiently indicated by the fact that the ravages of these parasites on our cereals and fodder plants, to say nothing of plants grown for pleasure, amount to many millions sterling every year, and that entire planting enterprises have been ruined by them.

But the subject of heterœcism has equally important bearings on the scientific philosophy of plant life, closely bound up as it is with the large questions of parasitism, and the nature and origin of species.

Klebahn's book is divided into two parts. The first 204 pages are concerned with the general aspects and discussions of the whole subject, the rest of the work with the special description and biology of each species in succession.

A mere enumeration of the headings suffices to show how interesting and important are the themes discussed in part i. Beginning with definitions and the history of the whole question of heterœcism, and a summary of the principal types of rust-fungi concerned, the author passes, in section iv., to an account of the means of distribution, and the conditions of germination and infection of the various kinds of spores produced by these remarkable fungi.

Certain controversial questions are then examined and answered. Klebahn emphatically declares (p. 43) that no evidence of value exists to show that the host which bears teleutospores can be infected by sporidia. He also examines the question of the necessity of heterœcism, and concludes that for some forms it is indispensable, though there are many which are known to be able to do without it. Some of the latter have a perennial mycelium, the classical example being De Bary's *Æcidium elatinum,* which induces the witches' brooms on silver firs.

By far the most exciting part of Klebahn's general exposition is that which deals with the wheat-rust problem and Eriksson's mycoplasma hypothesis. The wheat-rusts are held to be heterœcious, but able to dispense with the change of hosts. The wintering of uredo-spores is not regarded as sufficient to explain the infection of plants in the spring. But if the æcidium form is absent, and no uredo-spores have survived the winter, how is it the cereal shows infection next spring?

Klebahn insists on the importance of the world-wide distribution, in vast quantities, of the rust and of wheat culture, and that the wind can carry the spores, *as it can far heavier particles such as grains of dust,* hundreds of miles at a stretch, and Marshall Ward's experiments with the uredo-spores of *Puccinia dispersa* prove that such spores may retain their germinating power for sixty-one days.

Eriksson has entirely failed to grasp the significance of these facts, and his hypothesis of a latent and undiscoverable mycoplasm is not only superfluous, but has entirely broken down under the criticism of Marshall Ward's investigations, which show that the so-called incipient mycelia proceeding from "mycoplasm" are nothing but the normal haustoria of the fungus.

Section ix. deals with the distribution of rust-fungi and their passage into new regions. Section x. with methods, not only of culture and infection, but also—far too briefly—with the details of microscopic preparation. Section xi. is devoted to the problems of geographical areas of distribution, and contains much interesting information about the rusts of various countries.

In section xii. Klebahn illustrates, with ingenious diagram tables, the vagaries of these parasites in their choice of host-plants, and then passes to the discussion of the second of the two great burning questions of the rust problem, viz. the phenomenon of specialisation of parasitism, with which Eriksson's name must always be honourably associated.

Put shortly, the matter stands thus. Although a given species of rust-fungus is found on two host-species A and B, and although no trace of difference can be discovered with the microscope in the two cases, nevertheless the fungus on A will not infect B, nor will that on B infect A. This has been so abundantly and thoroughly proved by the researches of Eriksson, Klebahn, Marshall Ward and others that there can be no doubt as to the facts. The explanation appears to be that the fungus on A is so closely adapted to the physiological peculiarities of its host A that it cannot

suddenly alter its habits when placed on another host B to which it is not yet attuned, and consequently fails to infect B. But, as Marshall Ward showed, the host B may be merely a closely related variety of A, whence we must infer that the differences of food-material and so forth may be very small, and it is not surprising that occasionally a spore from A may succeed in infecting B, possibly when the latter is "off its guard," as it were, and short of its supplies of resistant materials or unduly lavish of its stores of attractive substances, or possibly because the spore in question happens to be better equipped than usual with the necessary solvents or poisons needed to break down the normal resistance of B. Be this as it may, once the fungus of A has gained a hold on B, it can now go on infecting B by means of its spores—it has now adapted itself to B.

But Marshall Ward showed that, while the fungus on A may fail to infect B, it may be readily able to infect a third related variety of host-plant C, and after adapting itself to C it may then pass easily to B; thus C becomes a bridging form from A to B.

Klebahn in sections xiv. and xv. discusses these matters, and the gradations of specific variation and their bearing on the theory of descent at great length, and concludes,

"The manifold characters of the existing biological species and races appear to have come into being owing to the alternating extensions and restrictions of the area of nutritive plants. These changes, and especially the restrictions of area, have been influenced by adaptation and selection, but many observations indicate that internal developmental tendencies, as yet entirely unexplained, have also played a part in determining the direction of the evolution."

Not much is gained by the latter phrase, but it at least shows the lines along which the thoughts of modern pathologists are tending.

Section xvi. deals with the question of the origin of heterœcism. Klebahn appears to doubt whether the increase of virulence said to be exhibited by Æcidium spores from barberry, as contrasted with uredo-spores grown on the wheat itself, can be maintained, and inclines to the belief that an advantageous utilisation of the periodic phenomena of vegetation is rather the key to the problem.

The author then proceeds to the discussion of predisposition, and accepts Marshall Ward's researches showing that anatomical peculiarities on the part of the host-plant do not explain it, concluding that in part chemical constitution, in part forces or factors of unknown nature in the protoplasm, are at the bottom of the question.

The concluding section of this part concerns the spermogonia, and views as to the alleged sexuality of the rust-fungi. The view is maintained that the spermatia are now functionless, and the author doubts the sexual character ascribed by Sappin-Trouffy and Dangeard to certain nuclear fusions in the development of teleutospores.

Part ii. is essentially a work of reference for investigators, and deals very thoroughly with all the special points in the biology of the various species of heterœcious Uredineæ raised by the Tulasnes, De Bary, Dietel, Fischer, Magnus, Eriksson and Henning, Marshall Ward and other workers, including—by no means the least important—the author himself.

A very complete account is given of Eriksson's work on the rusts of the cereals, and of that of Marshall Ward on the brome rusts, and it is probably not too much to say that a more thorough and masterly work on the subject has never yet been produced.

That Klebahn's work will have a wide influence in furthering investigation into these extraordinary and important parasites cannot be doubted.

A STUDY OF RABIES.

Rabies: its Place among Germ-diseases and its Origin in the Animal Kingdom. By David Sime, M.D. Pp. xii+290. (Cambridge: University Press, 1903.) Price 10s. 6d. net.

THE admiration with which we must regard Pasteur's studies on rabies is increased by the fact that the actual microbe which causes the disease is unknown. Pasteur, nevertheless, by a logical application of the facts known concerning other pathogenic microbes, triumphed over this difficulty, and presented the world with a method of preventive inoculation against hydrophobia. He owed this achievement to the rigid and laborious series of experiments with which he was scrupulously careful to control his theories.

It is strange that Dr. Sime, with this example constantly before his eyes, should have been absolutely blind to its lesson. Anyone who seriously proposes to add to our knowledge of rabies must follow Pasteur's methods. No advance is likely to be made by the most ingenious reasoning unsupported by practical demonstration; we have no use at all nowadays for armchair pathology. Dr. Sime's work is beautifully printed and written in excellent English; it bears evidence of very wide reading and of careful though fanciful thought. But it is wordy to an exasperating degree, and the perpetual use of inverted commas and italics becomes almost a nightmare. There is no evidence from first to last that the writer has attempted to substantiate any one of the remarkable views which he sets forth by a single practical experiment.

There is room in the English language for a good monograph on rabies, but instead of giving a plain and straightforward account of what is at present known about the disease, which it is probable that Dr. Sime would have been competent to do, he presents us with a "study" of rabies from a number of theoretical standpoints, at times embroidered with excursions into transcendental bacteriology. It must suffice here to give a few examples only of the strange views supported by the author. The discussion as to the order of germ-diseases to which rabies belongs is based on a classification with which we are unfamiliar. Dr. Sime sharply divides infective diseases into two groups those which protect against future attacks and those which do not; for these he employs the singularly unhappy names "prophylactic" and "preventive" respectively. Why a disease which does not protect should be called "preventive" is not

explained, nor does it much matter; every degree of protection can be traced amongst infective diseases, and no such sharp distinction exists as that set forth by Dr. Sime. We learn that the rabies microbe is strictly "preventive," and in the course of the argument much stress is laid upon a misleading analogy between the rabies virus and alcohol—a mistake which might have been avoided had the author's studies included Ehrlich's work on the fundamental differences between such a poison as alcohol and the bacterial toxins which contain a haptophore atom-group.

A chapter is devoted to proving the "multiform structure" of the rabies microbe, illustrated by diagrams as fanciful as the speculations upon which they are based. In a chapter on rabies of the sympathetic system, the virulent character of the saliva in paralytic rabies is explained on the theory that the salivary glands are invaded through the sympathetic nerves. Inasmuch as stimulation of the sympathetic checks the secretion of the submaxillary gland, while stimulation of the chorda tympani excites it, we fail to follow the line of reasoning. In any case Dr. Sime should have put his views to the test by laboratory experiment. But perhaps the high-water mark of irresponsible speculation is reached in the chapter on the relation of bacterial agency to secreting organs, in which the novel view is propounded that not only poisonous secretions in animals and plants, but even digestive secretions owe their existence to a bacterial commensalism in the tissues. As regards the origin of rabies in the animal kingdom, Dr. Sime doubts its primitive canine source, and is inclined to trace it to the "intensifying" division of animals, and in particular to the rabbit, which, exhausted by being hunted, contracts the disease in some unexplained manner from the soil, especially when its ears are frost-bitten. We fear that we must regard this book as an example of the unscientific use of the imagination, and we should not have devoted so much space to it had it not been issued by the Cambridge University Press.

MINING AND QUARRYING.

The Elements of Mining and Quarrying. By Sir C. Le Neve Foster, D.Sc., F.R.S. Pp. xviii+321. (London: Charles Griffin and Co., Ltd., 1903.) Price 7s. 6d. net.

ONE of the most difficult tasks in the field of technical literature is the preparation of a thoroughly good elementary text-book of an industrial art, and the difficulty is especially conspicuous when the subject dealt with is mining, with its incursions into mathematics, physics, chemistry, geology, mineralogy, civil engineering, mechanical engineering, electrical engineering, law, and sanitary science. It is not astonishing that the task has not hitherto been attempted. In French and German there are several useful works of the kind; but in English, elementary text-books have dealt exclusively with but one branch of the subject, the best example being the rudimentary treatise written a generation ago for Weale's series by the late Sir Warington Smyth.

In 321 pages the late Sir C. Le Neve Foster has covered the whole range of mining and quarrying. With an intimate knowledge of his subject, he combines great clearness of style and a thorough grasp of the beginner's needs. Superfluous detail is carefully avoided, and the arrangement of the matter is eminently logical. Each of the sixteen divisions of the subject is concisely expressed by a single word:—(1) occurrence, (2) discovery, (3) boring, (4) excavation, (5) support, (6) exploitation, (7) haulage, (8) hoisting, (9) drainage, (10) ventilation, (11) lighting, (12) access, (13) dressing, (14) legislation, (15) health, and (16) accidents. These easily remembered headings serve as pigeon-holes in which a student may file his notes upon any mine or quarry he visits. Into this comprehensive system, subjects from widely different fields of science and technology are combined by the author, with the result that his text-book forms, without undue burden of references, a thoroughly trustworthy guide for the beginner in mining, and in many respects for the experienced miner, who is apt too often to specialise in one branch of mining and to ignore the progress made in other branches. The beginner is wisely urged to deal with the subject broadly, and not to confine himself to the narrower sphere of the coal-miner or of the seeker for ores. After mastering the general principles of his art he can specialise later.

This has always been the method of teaching adopted at the Royal School of Mines. Half a century ago Sir C. Le Neve Foster's predecessor in the chair of mining expressed the view that he would never dissociate entirely the art of working collieries from that of working metalliferous mines, since both had much in common, and the one might often profitably borrow an idea from the other. He thought, however, that in the various districts where schools in the future might be established it would be needful to devote more attention to one department than to another, and according to the opportunities of the teacher to select special portions for fuller and more practical instruction. The success of the broad treatment adopted at the Royal School of Mines is clearly shown by the large number of associates of that institution that are occupying positions of eminence in the divergent fields of coal, ore, and precious stone mining in all parts of the world, and by the fact that at the provincial educational institutions of more recent formation the specialised mining instruction is, almost without exception, in the hands of old students of the parent school.

One of the original features of Sir C. Le Neve Foster's book is that he insists that from the very outset the student should seek to acquire some information concerning the laws regulating mining and concerning the diseases and accidents incidental to the miner's calling. This new departure deserves warm commendation. Mining differs from most other occupations by being regulated by special statutes, and with an uncongenial branch of the subject like law the student needs special help. The labour question, too, is of so much importance and often so much more difficult to solve than the extraction of mineral from the ground, that the student cannot fail to be grateful

for guidance in the task which in his future career he may have to face, of collecting workmen in inaccessible districts, of housing them, and of looking after them generally.

The work contains 281 illustrations, some being drawings to scale and others reproductions of photographs, showing in a striking manner the operations of mining and quarrying. All are excellent, and, like the letterpress, are exceptionally well printed. A very full and accurate index greatly adds to the value of the book.

B. H. B.

SOME BOOKS ON QUATERNIONS.

Étude sur les Quantités mathématiques. Grandeurs dirigées, Quaternions. By Prof. Claro Cornelio Dassen, D. es Sc. Pp. vi+133. (Paris: A. Hermann, 1903.) Price 5 francs.

Introduction to Quaternions. By the late Profs. Philip Kelland, F.R.S., and P. G. Tait. Prepared by C. G. Knott, D.Sc. Pp. vii+208. (London: Macmillan and Co., Ltd., 1904.) Price 7*s.* 6*d.*

Bibliography of Quaternions and Allied Systems of Mathematics. Drawn up for the International Association for Promoting the Study of Quaternions, &c. By Alexander Macfarlane, D.Sc., LL.D., F.R.S.E., General Secretary of the Association. Pp. 86. (Dublin: University Press, 1904.)

IT may perhaps be rather an exaggerated statement, but it is none the less to a great extent true, that mathematicians tend to divide themselves into two classes, quaternionists and non-quaternionists, and that these two classes frequently become involved in polemical controversies. But at the present time the notion of vector quantities is of frequent occurrence in physics, and it is important that everyone should have an opportunity of understanding the laws and nature of vector operations. It is not unfrequently stated that forces are vectors, because they are directed quantities, and *therefore* they are compounded by the parallelogram law. But the moment of inertia of a body about a line is also a directed quantity in the sense that its magnitude depends on the direction of the line, although moments of inertia, as every mathematician knows, are *not* compounded by the parallelogram law. Clearly dogmatic statements about vectors are dangerous for teaching purposes.

Dr. Dassen's book deals with a much wider field than the study of quaternions proper. The first part treats of "the concept of quantity," *i.e.* the fundamental laws of algebra. The second part is divided into three chapters, which treat of directed quantities in space of one, two and three dimensions respectively, so that it is only in this last chapter that the particular system of algebra associated with the name of Sir W. R. Hamilton is discussed.

Prof. Knott's edition of Kelland and Tait's book is a typical English text-book of a kind such as writers of other nationalities rarely produce. By this we imply that it is full of worked illustrative examples, and at the end of each chapter is a copious collection of examples for exercise. The first five chapters, extending up to p. 89, would form an excellent course for a student whose time is short.

The chapter on dynamical applications is an important innovation which might well be extended in the interest of science students by the addition of more elementary examples. Chapter vi., dealing as it does with "cones and their sections," possesses little interest for the modern student. It would have been more useful thirty years ago, when it was the fashion not to teach the calculus until the student had learnt by heart a series of propositions for the parabola, a second series for the ellipse, and a third series (scarcely ever properly understood) for the hyperbola. Nowadays more suitable illustrations may be obtained from physical problems without wasting time over these elaborate discussions about conics. On the other hand, chapter vii., dealing with central *surfaces* of the second order, is less detailed in its treatment, and consequently likely to be more helpful.

Dr. Macfarlane is to be congratulated on the very complete list of papers which he has succeeded in drawing up for the association of which he is secretary. These papers, we notice, cover different systems of multiple algebras, discussions on the geometric representation of complex magnitude, and nearly every book, pamphlet or paper on mathematics or physics in which quaternions or allied systems of mathematics play any part whatever, such, for example, as Clerk Maxwell's "Matter and Motion" or Minchin's "Statics." The only improvement that can be suggested is a classification of the papers by which those merely containing references to quaternions should be separated from those which treat of a substantial portion of the general theory of algebras of vector quantities.

OUR BOOK SHELF.

A Manual of Zoology. By Richard Hertwig. Translated and edited by J. S. Kingsley. Pp. xi+704. (London: G. Bell and Sons, 1903.) Price 12*s.* 6*d.* net.

THE English student of zoology has now the choice of a large number of excellent text-books, varying in style, in thoroughness, in wealth of illustration, but sufficient for the purposes of his education up to the time when his more advanced studies require him to turn his attention to the writings of foreign authors in their original language. To add to the list, the translation of a foreign text-book requires some special justification. It must provide something, some special treatment of a subject or some philosophical speculation which has not been provided by those who, with a knowledge of the needs of our own students, have written text-books for their guidance. The great reputation of Prof. Hertwig would lead us to expect a text-book from his pen that would justify its translation into the language of any country where zoology is seriously studied, and in some respects we are not disappointed.

The book opens with a definition of general terms and a short history of the development of the science from the time of Aristotle to the present day, which are admirably concise and clear. The pages dealing with general morphology and physiology are also decidedly excellent, better, perhaps, than are the corresponding parts of any other modern text-book. In the portion dealing with special zoology, however,

there are many features which detract from its general merits. We might point out, for example, that the description given of the important group Protracheata is insufficient, and the statement that the animals included in it are viviparous is erroneous. The classification of the Pelecypoda adopted in the text is old-fashioned and by no means the best.

The statement on p. 206 that in Ciliata there is *a* micronucleus is misleading. It should be one or more micronuclei. These and many other general statements are unsatisfactory. The book, moreover, is disfigured by numerous misprints. Such a misprint as Afri*d*a (p. 644) may not be of much consequence, but the misprints in the names of animals, such as My*l*ilidæ (p. 367), Chele*f*er (p. 450), Mac*h*rocheiroptera (p. 638), Strongylocentr*a*tus (p. 345), Saxica*r*a (p. 367), and a great many others cannot but mislead the elementary student of zoology.

A Guide to the Antiquities of the Bronze Age in the Department of British and Mediaeval Antiquities, British Museum. Pp. xii+159; 148 figures, 10 plates. (London: British Museum, 1904.) Price 1*s*.

The members of the staff of the British Museum who are responsible for the "Guide to the Antiquities of the Bronze Age," which has just been published, are to be congratulated on having provided the public with a most excellent little manual which is not merely a guide to the collections in our National Museum, but is at the same time a convenient text-book on the Bronze age. There had long been a lack of authoritative handbooks on archæology in English, and in this respect we were at a disadvantage compared with certain other countries in Europe. Thanks to the energy and knowledge of Mr. C. H. Read and his colleagues and to the liberality of the trustees, we are now provided with two well written, precise, and copiously illustrated shilling books which supply this deficiency for the Stone and Bronze ages, and we are glad to note that a volume on the Iron age is in course of preparation.

In the closely packed twenty-six pages of the introduction we have a succinct account of the evidence for a Bronze age and its relative chronology; the existence of an antecedent Copper age is discussed, and it is admitted that some countries do possess a distinct Copper age. The author leans to the view that bronze was first discovered in China in the fifth millennium B.C. The Aryans are treated to a brief discussion, and the position is taken "that the Aryan language was forced upon the aboriginal inhabitants of Europe towards the end of the Neolithic period by a stalwart race with short skulls and fair hair, who radiated from some point in south-east Europe . . . the new comers are sometimes known as the Alpine race."

The bulk of the little book is taken up not with a mere catalogue of objects, but with an instructive guide to the objects in the collection, and for the further elucidation of the culture of the Bronze age descriptions and illustrations are given of hut-circles, brochs, and a barrow. A considerable amount of space is taken up with objects from various countries on the Continent, and by this means the finds in our own islands can be placed in their relative position in the cultural history of Europe. The numerous illustrations in this book are carefully chosen and well executed, and the book can be highly recommended to curators, students, and the general public.

The Care of Animals. By N. S. Mayo, M.S., D.V.S. (Rural Science Series). Pp. xvi+459. (New York: The Macmillan Company; London: Macmillan and Co., Ltd., 1903.) Price 5*s*. net.

The agricultural reader who possesses Prof. Jordan's admirable text-book "The Feeding of Animals" will welcome this addition to the "animals" section of the Rural Science Series. The writer, Dr. N. S. Mayo, professor of veterinary science in the Kansas State College, indicates his standpoint in the following two sentences taken from the preface. "The day of the 'horse-doctor' book is passing. Prevention, sanitation, careful handling are more important than mere medication."

The first section of the volume, treating of the general care of animals, is a little disappointing. There is much common sense, but there is also a suspicion of padding. The illustrations of farm live-stock in chapter i. have no particular point, and one feels that a dozen pages of illustration and letterpress transferred from the first three chapters to the chapter on veterinary obstetrics would have been an advantage. When the writer comes to his own subject, the care of sick animals, there is a great improvement, and 400 pages are filled with just the kind of information that the stock-owner wishes to have. The chapters on the indications of disease and the nursing of sick animals are excellent. The descriptions of ailments, though quite free from medical terms, are pointed and so clear that even in the absence of professional assistance the farmer is likely to be able to recognise many of the diseases. The advice given is plain but guarded. The writer does not forget that there are medicines which may do harm, and he has given special prominence to the use of simple remedies; he urges the owner of valuable stock to take no risks, and when in doubt to consult a skilled veterinarian. For those unable to do this there is a short chapter on common drugs, doses and recipes. The book is likely to be popular in the British colonies, and its usefulness for the colonist would be increased if the sections on drugs and recipes were extended. In its present form, however, this addition to our agricultural text-books deserves popularity. To the stock-owner whose province it is to "nurse" rather than to "treat" the sick animal Prof. Mayo's volume will be most useful, and should be most welcome.

A Text-book of Ceramic Calculations, with Examples. By W. Jackson, A.R.C.S. Pp. xviii+67. (London: Longmans, Green and Co., 1904.) Price 3*s*. 6*d*. net.

This little book is designed to supply students in classes in pottery and porcelain manufacture with a collection of problems and examples to illustrate the application of mathematical and chemical methods to the solution of the problems with which the potter is constantly confronted in his work. The preliminary lists of chemical substances—with their formulæ, atomic or molecular weights, and specific gravities—and of minerals important from the potter's point of view should prove useful. The heading on pp. 12–14, "List of Elements," is unfortunate, seeing that the substances tabulated are mostly compounds. More exercises for the student to work out might have been supplied with advantage, for instance, to chapter ix. one problem only seems to be given.

Botany Rambles. Part i. In the Spring. Pp. iv+120. (London: Horace Marshall and Son, 1904.) Price 10*d*.

The anonymous writer of this book for children gives the following excellent advice to the youngster beginning to read the little volume: "If you have not time to read this little book and go out as well, then don't read it, but go out instead." The information provided is given in clear, simple language, and is of a kind that a sympathetic adult taking a child for a ramble would strive to make the young botanist find out for himself. The photographs of trees in the book are very good.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Complex Nature of Thorium.

WITH regard to several letters on thorium and its complex nature that appeared in NATURE of March 24 and 31, April 7 and 14, and in which my name is mentioned, I take the liberty of adding a few remarks, having had ten years' experience in working with thorium.

In 1897, at a meeting of the British Association in Toronto (Canada), I read a paper in which I pointed out that spectrum evidence proves the complex nature of thorium.

In 1898 (Chem. Soc. *Trans.*, p. 953) I isolated from some thorium fractions an earth with an atomic weight of 225·8 (tetrad). Knowing the difficulties of the separation of rare earths (I have been engaged in this kind of work since 1878), and not wishing to publish a premature conclusion, I did not declare this to be a novel constituent of thorium, but said that foreign earths were present, in spite of the fact that the reaction used ought to have separated them.

In 1901 I published another short paper (*Proc.* Chem. Soc., March 21, 1901, pp. 67–68), in which I said that "my experiments may be regarded as proving the complex nature of thorium." Thorium was split up into Thα and Thβ. With Thβ I obtained so low an atomic weight as $R^{iv}=220$. The fractions Thα gave by the analysis of the oxalate, though it was prepared by pouring the thorium salt solution into an excess of oxalic acid, in order to avoid the formation of a basic salt, the high atomic weight $R^{iv}=236{\cdot}3$. But I stated expressly, and I feel obliged to repeat it, that these fractions show a great tendency to form basic salts. Assuming these to be normal, a higher atomic weight than the true one is obtained. This is true especially in regard to the oxalate.

The splitting up of thorium into Thα and Thβ was, of course, not so sensational an event as the announcement from America of the splitting up of thorium into "carolinium" and "berzelium." BOHUSLAV BRAUNER.

Bohemian University, Prague, April 18.

Radio-activity and the Law of Conservation of Mass.

MR. SODDY in the Wilde lecture on the "Evolution of Matter as Revealed by the Radio-active Elements" (*Proc* Manchester Phil. Soc., vol. xlviii., part ii., p. 29) gives two methods of deducing the average life of a radium atom. The results become concordant if we assume that the complete disintegration of an atom of radium involves the emission of four α particles. Now the atomic mass of radium is 225, and that of an α particle about 2; the question therefore arises as to what has become of the rest of the mass.

There appear to be three possible answers to this question. In the first place Mr. Soddy's estimate may be wrong by a factor of ten, although it is hardly likely that the data are uncertain to this extent; secondly, the various stages of the disintegration may involve the liberation of non-radio-active by-products which would necessarily be incapable of detection by the methods of investigation employed; and, finally, there may be a decrease in the total mass of the system owing to the decrease in the velocities of some of the constituent electrons.

A priori the second hypothesis appears to have the balance of probability in its favour, as it agrees best with our present ideas; but I think the third solution should not be dismissed too hastily. In discussing the matter recently with Mr. G. A. Schott, I found that he also had been led to consider the tenability of this view in connection with some theoretical work on the structure of the atom which will probably soon be published. O. W. RICHARDSON.

Trinity College, Cambridge, April 19.

The Atomic Weight of Radium.

IN the *Philosophical Magazine* for April, 1903, Runge and Precht work out the atomic weight of radium from its spectrum to be 258, instead of the 225 found by Madame Curie. I should like to point out that the spectrum data of radium support the value given by Madame Curie, if handled according to Section v. of "The Cause of the Structure of Spectra" (*Phil. Mag.*, September, 1901). There is an important question of principle involved in the distinction between the two methods of using the spectrum of an element for determining its place in the periodic classification.

The method adopted by Runge and Precht is founded on a slight alteration of the approximate empirical law discovered by Rydberg, that, when similar elements have corresponding pairs or triplets of lines in their spectra, the difference of the frequencies of vibration of the two lines in a pair belonging to any one element is proportional to the square of its atomic weight. Runge and Precht alter this law by substituting the words "some power of its atomic weight" for "the square of its atomic weight." Thus in the alkaline earth family they give the power as 1/0·5997. The frequency differences of corresponding pairs of lines in Mg, Ca, Sr and Ba, namely, 91·7, 223, 801 and 1691 being denoted by x, the logarithms of the atomic weights M of these elements are given by the formula $\log M=0{\cdot}2005+0{\cdot}5997 \log x$. As x for radium is 4858·5, the value 258 is found by Runge and Precht for the atomic weight of radium. But the frequency differences are connected with one another by numerical relations, and not directly by their atomic weights.

The clearest instance of this purely numerical relationship is shown by the spectra of Zn, Cd, and Hg. A characteristic set of corresponding frequency differences for these elements is 386·4 for Zn, 1159·4 for Cd, and 4633·3 for Hg. The number for Zn multiplied by 3 gives 1159·2, which is indistinguishable from the value for Cd, and 12 times the number for Zn gives 4636·8, which is within 1 part in 1000 of the value for Hg.

In the paper mentioned I have shown how this numerical series, 1, 3, 12, appears elsewhere in the frequency differences for other families of elements, with a fourth member, namely, 28. Now these numbers are the first four terms of the series the general term of which is $1-3n/2+7n^2/2$. This series, and not atomic weights, controls the relations between the frequency differences for the spectra of allied elements.

Perhaps the most striking evidence in support of this assertion is afforded by some characteristic frequency differences discovered by Runge and Paschen in the complicated spectra of O, S, and Se. These are for O 3·7 and 2·08, for S 18·15 and 11·13, and for Se 103·7 and 44·07. Of these six numbers four are the first four terms of the series the general term of which is $3{\cdot}7(1-3n/2+7n^2/2)$, namely, 3·7, 11·1, 44·4, and 103·6. The numerical law applies, then, to the non-metals as well as to the metals. The distinction between a purely numerical and an atomic weight relation between the frequency differences of allied spectra is fundamental, the one implying a kinematical, the other a dynamical, origin for the structure of spectra.

As to the bearing of these considerations on the determination of the atomic weight of radium from its spectrum we can represent the differences given above for the alkaline earth elements by the formula $63{\cdot}8(1, 3, 12, 26)+31{\cdot}6$, in which 26 for Ba takes the place of 28 in the standard series. There are other instances in which a serial number like 12 or 28 is reduced by 2 or 4, a phenomenon probably of kinematic origin. For the next three elements of this family with higher atomic weights than Ba, the frequency differences corresponding to those just given should be the values of $63{\cdot}8(1-3n/2+7n^2/2)+31{\cdot}6$, given when $n=4$, 5 and 6. The coefficients of 63·8 are 51, 81 and 118. Now the 4858·5 of Runge and Precht for radium is $63{\cdot}8\times75{\cdot}7+31{\cdot}6$. Thus the 75·7 of radium corresponds to the 81 of the regular series in the same way that the 26 of Ba does to the 28 of the regular series. So the numerical law for the frequency differences places radium two main rows lower than Ba in the table of elements, and gives to it, therefore, an atomic weight exceeding that of Ba, namely,

137, by about 90. The spectrum evidence confirms then the determination 225 made by Madame Curie.

As quite a number of investigators are working at relations between spectrum data and atomic weight, it seems important to make generally known the fact that mathematical series, like that of Balmer's law or that given above, are the main feature in the laws of spectra. The approximate law of Rydberg arises from the fact that the atomic weights of the elements form a series. Certain relations between this series and the series belonging to the spectra of the natural families are probably the cause of Rydberg's approximate law, which is not suitable for the extrapolation attempted by Runge and Precht with their modified form of it, unless other better means of estimating the atomic weight are lacking. All that we are warranted in saying at present is that the atomic weights of some of the elements in a family are nearly proportional to some power of $A+B(1-3n/2+7n^2/2)$, where n has positive integral values, and A and B are parameters characteristic of the family.

William Sutherland.

Melbourne, March.

Graphic Methods in an Educational Course in Mechanics.

I should be glad if I could, through the columns of Nature, elicit opinions from those who have taught mechanics from the beginning as to the advisability of either omitting graphical methods altogether from an educational course in mechanics or of introducing them at a very late stage.

By graphical methods I mean those methods which depend entirely on the use of mathematical instruments of precision, and from which calculation is absent. I do not refer to the plotting of curves from results obtained analytically, or to such simple graphical considerations as enable one to draw (freehand) a useful working figure.

I myself, after many years of teaching, have come to the conclusion that until the principles of statics and dynamics have been thoroughly grasped, it is better to keep graphical methods out of sight altogether.

My contentions are as follows:—

(1) *Analytical methods give a grasp of the principles of statics, while graphical methods disguise them.* When a body is at rest and in equilibrium, the obvious facts are that it does not move in this direction or in that, and does not rotate. Now the idea of a *resolute* as the effective component of a force in any direction is one readily grasped, and the analytical statement that "the resolutes in any direction balance one another" brings vividly before the mind the equilibrium as regards *translation*. Any experiment made suggests this balancing of resolutes. But the closing of a polygon of forces, on the contrary, does not suggest, with anything like the same degree of vividness, that there is no translation. In fact, the closed polygon of forces, representing as it does a couple, rather suggests that there *is* rotation. An experiment with a body on an inclined plane, for example, suggests a balance of resolutes and does not suggest a triangle of forces.

Again, as regards *rotation*. The analytical method of the "balancing of moments" brings clearly before the mind the fact that the body does not rotate. I am sure that most people will agree with me when I say that the corresponding graphical proposition, that "the funicular polygon closes," will not suggest non-rotation to any ordinary learner.

(2) *Analytical methods must be mastered in any case.* In any educational course, it is important that the learner shall have to rely on as few principles as possible. Now when he has mastered the principles of "resolution" and "taking moments," he can be led to attack any useful problem in statics without further theory.

But he may master the "polygon of forces" and the "funicular polygon," and yet find himself totally unable to deal with machines and with other constantly occurring cases of equilibrium. He will find that, while he can obtain by graphical methods the resultant of a system of forces if these be parallel, he will probably fail if the forces be not parallel (and non-concurrent), owing to the difficulty of getting his diagram on to a given sheet of paper. In fact, analytical methods must be mastered, while graphical methods, however convenient in certain cases, need not be mastered save for special professional purposes. If, then, there be not time for both, it is the latter that should be sacrificed. A student well trained in analytical methods can always pick up graphical methods rapidly when he needs them for special work.

(3) *Analytical methods connect statics with dynamics.* I do not think that this contention will be disputed. Regarded analytically, statics are a part of dynamics; the equations are the same and the ideas are the same, only the acceleration, in statics, is zero.

(4) *Graphical methods confuse learners of statics.* Here I rely on experience, and report what I have observed. I have noticed, over and over again, that, while a learner of analytical statics may fail to solve a problem, he yet knows what he is trying to do, and he does not, as a rule, lose sight of principles.

But I find that beginners, who have learned something of graphic statics, appear to lose sight of principles altogether, and are content to make the wildest "shots." They make triangles out of ladders, walls, and ground, and continually take the lengths of bars or strings to represent the stresses in them in their attempts to "get a triangle of forces."

I find no beginner so difficult to teach as one who has learned some graphic statics at a preparatory school, and I much prefer those who have learned no statics at all. There seems to be something in graphical methods that paralyses the learner's powers of thought and reasoning, or at least allows them to slumber.

To sum up. I have come to the conclusion that graphical methods (as defined above) should be reserved for a relatively late stage in any educational course in mechanics, or even be omitted altogether until required for special work. In addition to the reasons given above, I may add that graphical work consumes an amount of time that seems out of proportion to the mental training and knowledge of principles gained.

W. Larden.

Devonport, April.

Sunspots and Temperature.

The following view of this subject (related to that given by Dr. Lockyer a short time ago) may be of interest.

Consider the last five sun-spot waves, as measured from the first year after a minimum to the next minimum, thus:—

(1) 1844–56 (13 years)	... ...	Maximum 1848
(2) 1857–67 (11 years)	... ...	,, 1860
(3) 1868–78 (11 years)	... ...	,, 1870
(4) 1879–89 (11 years)	... ...	,, 1883
(5) 1890–1901 (12 years)	.. ...	,, 1893

Using Wolf and Wolfer's sun-spot numbers, and finding the annual average for each of these waves, we get the curve marked A (dotted line) in Fig. 1 (p. 608).

Ascertaining next the averages of several meteorological items at Greenwich for those periods, we obtain curves B, C, D, E, F. The items are:—

(B) Mean temperature of winter (December–February).

(C) Frost days in winter (an inverted curve).

(D) Days with maximum temperature 70° or more (in year).

(E) Mean temperature of summer (June–August).

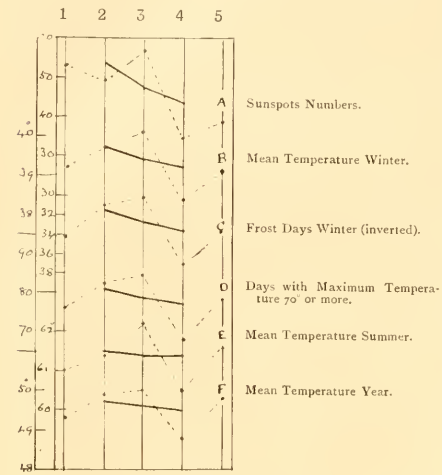
(F) Mean temperature of year.

The amount of agreement between these weather curves and the sun-spot curve seems remarkable. The sun-spot wave with *highest* average number (that for 1868–78) corresponds with the time of *greatest* warmth in each case, and

the sun-spot wave with *lowest* number (1879–89) with the time of *least* warmth. If the relative position of all five points does not exactly correspond in the solar and terrestrial curves, we should remember the large uncertainty necessarily attaching to sun-spot measurements.

We might smooth these curves with averages of three, getting the thick line curves, which indicate general decline (in a wide sense). Thus in the case of temperature, we find the grouped sun-spot waves 1, 2, 3, associated with more warmth than 2, 3, 4, and the latter with more than 3, 4, 5.

It is known that the recent researches of Nordmann, extending and confirming the work of Köppen thirty years ago, indicate a state of things in the tropics which is



essentially opposite to that in our region, that is, minimum of sun-spots is associated with *much* heat (relatively) and maximum with *little* heat.

I may here be allowed to submit for criticism a speculation regarding northern regions. I know little of temperature conditions in the Arctic regions and of ice in the Atlantic, and I suppose very little is known of these in their relation to the sun-spot cycle. Let us suppose, however (and the supposition does not seem a wild one), that it is in the Arctic regions as in the tropics, that is, more heat about sun-spot *minima* than about *maxima*, and that the Arctic *régime* is further opposite to ours in showing a general *rise* of temperature (in a wide sense) since the 'forties. (I may remark that Nordmann's data for the tropics seem to point to a gradual rise in the last thirty years.) What should we expect from this state of things? Would not the greater heat with minima cause more melting and loosening of ice, a more open season, and more ice to be carried down into the Atlantic? This would have a cooling effect on the Gulf Stream, and our temperatures would correspondingly decline. Thus heat in the Arctic would mean cold to us, and a gradual rise of temperature in the far north would mean a gradual fall in western Europe.

I have been told that a certain shrinking of the northern ice covering has been noticed in places in recent times, and I read lately, in connection with the voyage of the *Discovery*, that since Ross's time the Antarctic ice pack has broken back some thirty miles.

There may, however, be facts adverse to the above theory. Perhaps some of your readers may be able to throw light on the subject.

Alex. B. MacDowall.

A NEW EPOCH IN SOLAR PHYSICS.

UP to the year 1868 those rose coloured appendages round the solar limb, the prominences, could only be observed at the times of total eclipses of the sun. The ingenious method for watching these phenomena *any time* when the sun shines we owe to the labours of Lockyer and Janssen, and the striking of a medal by the French Government in honour of this important solar physical advance properly noted an epoch in this branch of astronomy.

By this new device, which was spectroscopic, the positions, forms, structure and movements of the prominences that encircle the solar disc could be accurately watched and determined, and we owe a debt of gratitude to such men as Respighi, Tacchini, Ricco, Mascari and others for the great work they have accomplished in taking advantage of this new line of research by recording daily the state of the solar limb in respect to these appendages. It must not be forgotten that all this work has been accomplished by *eye* observations alone. Sweeping round the solar limb and noting accurately the position, form, &c., of each prominence is not the work of a moment, even if the sky is clear, and it is astonishing what a great amount of valuable information has been gathered by this apparently sluggish method. When it is considered that one sweep of the spectroscopic slit round the solar limb only makes us acquainted with the prominences that exist in a very small section of the solar atmosphere and at only one particular moment of time, it was natural that early attempts were made not only to employ photography as a means of quickly recording these, but of devising, if possible, some method by which prominences *on* the solar disc itself could be also photographed.

It is not the object of the present article to trace the history of the development of the instrument, the photospectroheliograph, which now affords a means of satisfying these and other unlooked for requirements, but to give an account of the latest form adopted and results obtained by Prof. George E. Hale, of the Yerkes Observatory, to whom belongs a large part of the credit of designing and constructing an instrument capable of giving most successful results.

It may nevertheless be mentioned that Janssen in 1869 conceived the first idea of the method; he was followed by Braun, of Kalocsa, in 1872, and by Lohse, of Potsdam, in 1880. In 1889 Hale commenced work in this direction, and after him came Evershed in England and Deslandres in Paris, who both designed and used instruments which gave excellent results.

From time to time Prof. Hale has published accounts of the design of, and work accomplished by, his former instruments, but in a recent publication[1] he gives us a very full and detailed description not only of the latest form he has adopted, but of the magnificent photographs which he has secured with it.

To pass then at once to the modern photospectroheliograph, reference may first be made to the principle involved. The feature of the instrument is that it is capable of giving us pictures of the sun in light of one wave-length, or in monochromatic light. The instrument itself differs little in principle from an ordinary spectroscope if the eye-piece be replaced by a (second) slit. If the solar image be thrown by means of a lens on the first slit, then after the solar light has passed through the lenses and prisms of the spectroscope it will fall on the second slit, which will only allow a narrow portion of the spectrum to pass through it

[1] *Publications* of the Yerkes Observatory, vol. iii. part i.; also the *Astrophysical Journal*, vol. xix., No. 1, p. 41.

corresponding in width to this slit. The position of this second slit is, however, adjustable, and it can be made to coincide with any line in the solar spectrum. Thus any particular line can be completely isolated by this device. If now the solar image falling on the first slit be kept stationary, and the whole spectroscope be moved in a plane at right angles to the axis of the incident solar beam and in a direction at right angles to the length of the first slit, then the light that will pass through the second slit will be a succession of images in monochromatic light corresponding to the strips of the solar image which entered the first slit.

By adjusting the second slit on, say, the K line of calcium, and placing a photographic sensitive plate fixed independently of but nearly in contact with the surface of the second slit, then while the first slit is passing over the solar image, the second is moving over the film of the photographic plate at rest and allowing the monochromatic calcium K light to impress its successive images on the plate. The result is a picture of the sun in "K" light. Isolating different lines by means of the second slit, various monochromatic images of the sun in different "lights" can be secured.

An instrument made on the above principle is the ideal form to be used, but it can only be adopted when sunlight is thrown by means of a heliostat on to the lens which forms the image. It may be mentioned, by the way, that an instrument on this principle has recently been erected at the Solar Physics Observatory, South Kensington.

Prof. Hale wished, however, to employ his spectroheliograph in connection with the great Yerkes refractor of 40 inches aperture, so that he was obliged to adopt another method, because the movement of the spectroheliograph, which is of considerable weight, across the solar image formed at the focus of this large lens would have made the telescope vibrate, and produced in consequence bad solar images.

The method which he eventually adopted was to keep the whole spectroheliograph still in relation to the telescope itself, and to move the solar image uniformly across the first slit by means of a motor which actuated the declination slow motion of the telescope. Another difficulty then arose as regards the movement of the photographic holder, for this had to be made to travel across the second slit at the same uniform speed as the image over the first slit; this was finally overcome by connecting the plate holder directly with the declination motor, thus moving them simultaneously.

Although very similar in principle to the ordinary spectroscope, the spectroheliograph is different from it in many important details. In the first place both slits, instead of being straight as is usually the case in spectroscopes, are curved, and curved to a radius which is determined by the material of the prisms employed. Again, it is most convenient if the two tubes, carrying each a slit with its respective objective, and corresponding to the collimator and telescope tubes of the ordinary spectroscope, are arranged parallel to each other. This is accomplished by inserting between the collimator lens and the prisms (two in this case) a plane reflector which can be so adjusted that the light, after being reflected and passing through the prisms, emerges parallel to the beam falling on the reflector or to the collimator's axis.

By the use of the reflector in this position, thus rendering the prisms clear of the optical axis of the collimator, the instrument may be employed for another line of solar research, because when greater dispersion is required, as will be described further on, a grating may be inserted in its place. The optical arrangement, as briefly described above, can be seen from the accompanying illustration (Fig 1), which shows this portion of the instrument alone. To indicate the path of the beam of light from the collimator objective to the second slit objective a white line has been drawn, the direction being indicated by the arrow head.

For further information regarding the details of the construction of the instrument the reader may be referred to Prof. Hale's account, but a few dimensions may be given here. Since the solar image formed by the forty-inch telescope measures seven inches in diameter, the two slits, both being supplied with the necessary means of adjustment, are eight inches long. The collimator and camera lenses are of the portrait type by Voigtländer, and are of equal aperture ($6\frac{1}{4}$ inches) and focal length. These lenses are really too small for the large solar image dealt with, but Prof. Hale's statement that the considerable cost of lenses of about ten inches, the required size, rendered their purchase difficult explains this defect.

Passing over several important points that are vital to the efficient working of this instrument, which would

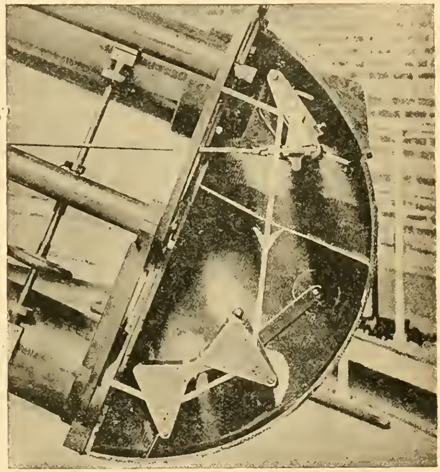


Fig. 1.—Showing the optical arrangement of the Spectroheliograph.

here take up too much space even to refer to at short length, such as a description of the movable plate-holder, the adjustment of the several parts of the spectroheliograph, the value of diaphragms to reduce diffuse and reflected light, the method of setting the second slit on any particular line in the spectrum, &c., we now come to describe some of the results which are the first fruits of this research.

It has been stated above that if a line due to calcium be isolated by the second slit then we shall obtain a picture of the sun in calcium light; if a hydrogen or iron line be used, then a hydrogen or iron solar picture will be obtained. The lines which are the most easy to employ, and which give the best results, are those of H and K due to calcium. These lines in the solar spectrum (Fig. 2) are broad, of a composite structure, and are composed of three main parts, (1) a broad, dark band, designated by Prof. Hale as H_1 or K_1, (2) a comparatively narrow, bright line, lying at the centre of this band at points on the sun's disc where the slit crosses hot masses of calcium vapour (H_2, K_2),

and (3) a very narrow, dark line running through the centre of H_2 and K_2 designated H_3 and K_3.

Now according as the second slit is made to isolate any part of either of these lines, so a calcium picture of the sun corresponding to this particular part of the line is obtained.

It may perhaps be mentioned that the name "flocculi" is here employed to designate the clouds of vapour which are photographed with the spectroheliograph. When the calcium line is employed "calcium flocculi" are photographed, or if the hydrogen line be used we obtain "hydrogen flocculi." These flocculi are, according to Prof. Hale, situated at a greater level above the photosphere than the "faculæ," the latter being elevated regions of the photosphere.

As the width of the H and K bands depends on the density of the calcium vapour, and the denser calcium in the sun is below that of less density, the pictures of the sun secured by using different parts of these lines will correspond to different levels. In fact, a means is thus employed of photographing sections of the calcium vapour, or of sounding the solar atmosphere with respect to this element. Thus, if the second

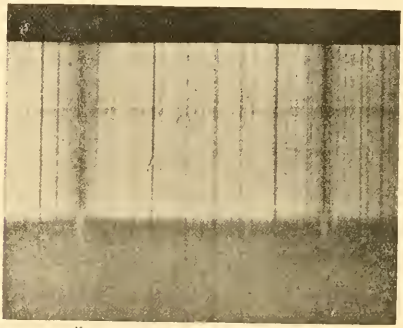


FIG. 2.—Reproduction of a photograph showing the H and K lines of calcium in the solar spectrum when large dispersion is employed.

slit be set at the extreme edge of H_1 or K_1, the resulting photograph will only show that calcium vapour which is dense enough to produce a line of this breadth, in fact, a section across the base of the calcium flocculus will be obtained. If set nearer the centre of the line a section of the flocculus corresponding to a higher level will be produced.

Further, this calcium picture in the final positive is always bright on a dark background no matter which parts of the H or K lines are employed. That this is so can be seen from Prof. Hale's pictures taken in the H_1 or H_2, or K_1 or K_2 light; this is an important point to which reference will be made later.

An examination of several photographs has led Hale to deduce that the calcium flocculi when secured with the slit nearer H_3 or H_2, or K_3 or K_2 are more extensive than those taken near the outer edge of H_1 or K_1. It is argued from this that the calcium flocculi are most probably in general composed of a series of columns of vapour expanding as higher levels are reached, and possibly overhanging laterally (Fig. 3).

To explain this point a little more fully perhaps the accompanying diagram (Fig. 4) may prove of service. In the centre of the diagram is drawn (on rather an exaggerated scale) the H line of calcium, and below this are lettered the detailed portions of it according to Hale's nomenclature. Above this are drawn three layers to represent three strata of calcium vapour corresponding to the width of the H line, which varies according to the density of the vapour. To investigate the distribution of the densest layer the portion H_1 of the H line is used, H_2 is employed for the less dense layer, and H_3 for the least dense.

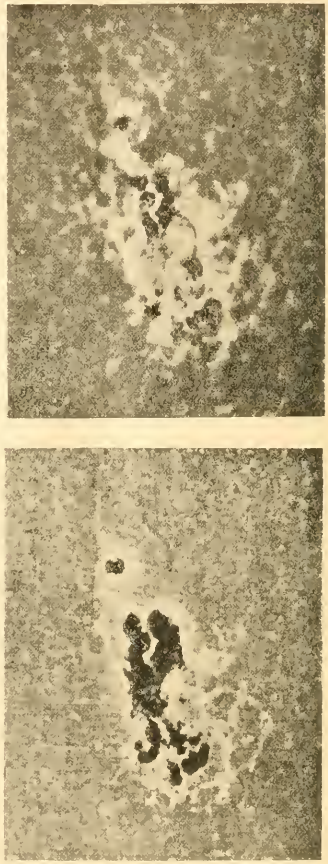


FIG. 3.—Showing that the bright calcium flocculi are more extensive at the H_2 level (upper photograph) than at the H_1 level (lower photograph). Notice that the spot is nearly obliterated at the H_2 level.

At the right-hand side of Fig. 4 is a sketch of a portion of the solar surface taken separately with H_1, H_2, and H_3 lines, and we have therefore the H_1, H_2, and H_3 flocculi. As, according to Hale, the area of the H_3 flocculus is more extensive than that of H_2, and H_2 more extensive than that of H_1, if we project this to gain a mental image of the vertical distribution of this calcium vapour we obtain an object somewhat after that drawn above the three calcium flocculi.

In fact, the object will take a form which is very like a tree-like prominence.

It is therefore of great interest to examine the same region of a large spot as photographed at two different levels, as in Fig. 3.

This illustration shows the region of the large spot of October 9 of last year, and the secondary slit was

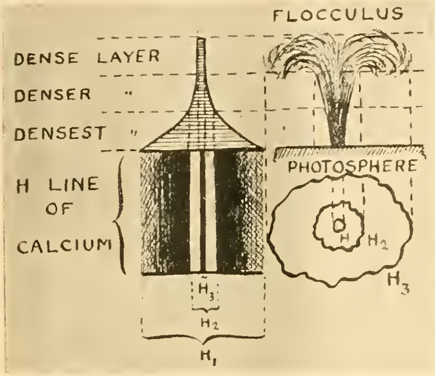


FIG. 4.—Diagram to illustrate the relation between the various portions of the H calcium line, the layers of different density, the resulting extent of the calcium flocculi and the probable appearance of their vertical sections.

placed at the middle of the calcium H_1 level (lower picture), and at the calcium H_2 level (upper picture); the plates were exposed at 3h. 43m. and 3h. 30m. p.m., so that they may be taken to represent approximately the solar conditions at these two different levels for the same moment of time. The actual spot itself is best seen at the H_1 level, where the flocculi are not so extensive. At the H_2 level the spot is nearly completely covered up by the flocculi, which are here far more pronounced and extensive. At this level the calcium vapour overhangs parts of both the umbra and penumbra of the spot.

The general appearance of the disc of the sun taken in calcium light is shown in the accompanying figure (Fig. 5). Under good atmospheric conditions the whole disc is covered with minute structure resembling somewhat the granulation of the photosphere. Scattered along distinct zones in both hemispheres are large bunches here and there of flocculi.

These masses of flocculi partake of the general movement of rotation of the disc like the spots. Not only do their areas vary very considerably from time to time, but the positions at which they make their first appearance change both as regards latitude and longitude. The enormous extent of these calcium flocculi in relation to the solar disc, and their variation in amount from time to time, a fact also known, suggest that here we have an indication of solar action that has only up to the present time been feebly shown by spots.

It is the investigation of the amount and distribution of these flocculi from day to day and from year to year that makes the spectroheliograph such an important instrument at the present moment, for it is the only means existing of recording these important phenomena.

Not only has Prof. Hale employed the calcium lines in this work, but he has used other lines, notably those of hydrogen. For this investigation the plane reflector used in the optical train of the instrument is replaced by a grating, as larger dispersion of the spectrum has to be obtained. By this means the hydrogen or other lines are rendered somewhat broader, and it then becomes possible to isolate them completely by the second slit, the width of which is adjusted to be less than that of the lines employed, in order to cut out the continuous spectrum on both sides. Numerous photographs were secured with each of the $H\beta$, $H\gamma$, and $H\delta$ lines, and comparisons were made with the calcium photographs.

The striking point which this comparison at once showed was that where on the solar disc the calcium flocculi did not exist the hydrogen flocculi were most apparent (Fig. 6), or, as Prof. Hale says, "the hydrogen flocculi are, in general, dark, and that while they have a general resemblance in form to the bright calcium flocculi, the differences are in many cases very striking."

Perhaps a short digression may here be made, as it does not seem quite clear, at any rate to the writer of this article, what Prof. Hale really means by the terms "dark" hydrogen or "dark" calcium flocculi.

The principle of the spectroheliograph is that if a calcium line be chosen to work with, then the resulting solar disc is built up of two kinds of markings, namely, (*a*) where the calcium exists (bright), and (*b*) regions where it does not exist (dark). Further, as has already been pointed out, it does not matter which part of the calcium lines is used, as both the dark and bright parts produce bright calcium flocculi on the completed positive. Again, if a hydrogen line be used we have a disc built up of two kinds of markings, (*c*) where the hydrogen exists (bright), and (*d*) where no hydrogen exists (dark).

Since the *existence* of each of these substances on the sun's disc is indicated by *bright* markings, it is not quite clear why Prof. Hale calls the dark patches

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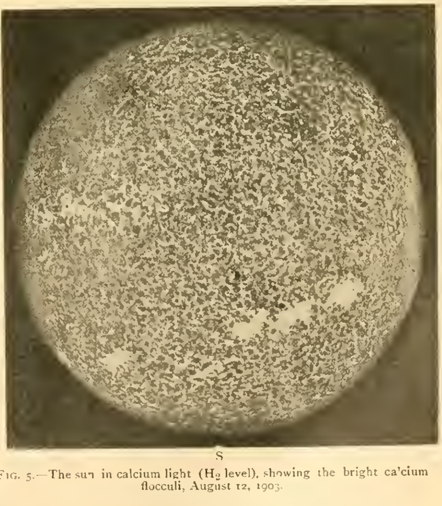
E  W

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FIG. 5.—The sun in calcium light (H_2 level), showing the bright calcium flocculi, August 12, 1903.

dark calcium or *dark hydrogen*, as in these parts calcium and hydrogen respectively are, according to the very principle of the spectroheliograph, shown to be *absent*.

It seems preferable to say that the regions where calcium exists correspond to those regions where hydrogen is absent than to say that the bright calcium flocculi resemble in form the dark hydrogen flocculi.

To show the confusion to which such a form of description as the last mentioned can lead one, a good instance is given on Plate viii., Figs. 3 and 4, of Prof. Hale's publication. There are shown two illustrations of the same region of the sun, one taken with the calcium line (K_2), and the other with the hydrogen line ($H\beta$). On each of these there is a peculiarly shaped *dark* patch, evidently the same region on the solar disc, and the photographs show that in this region neither calcium nor hydrogen is present. According to Prof. Hale's notation, this patch should be called both a "dark calcium" *and* "dark hydrogen flocculus"! As a matter of fact, the marking might be due to quite another substance altogether, and although it appears dark when analysed with either

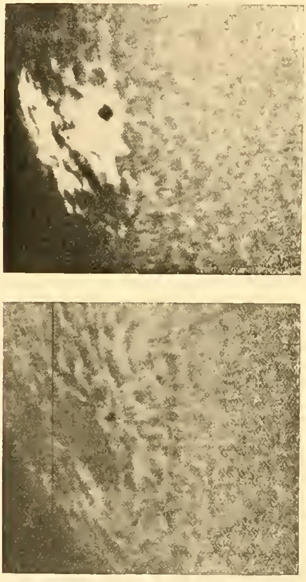


Fig. 6.—Two photographs of the same region of the solar disc taken on the same day, showing that where the bright calcium flocculi are present (upper photograph), the bright hydrogen flocculi (lower photograph) are absent.

the calcium or hydrogen lines, it might appear as a "bright flocculus" if a line in the spectrum of the substance of which it is composed were used. Thus if at the particular levels at which the photographs were secured we knew that helium had been present in this region, then it would have been shown on the photograph as a dark patch if the calcium and hydrogen lines had been employed, and as a *bright* one if any of the helium lines had been isolated by the secondary slit.

Enough, perhaps, has been said to indicate that what is meant by the "dark hydrogen or calcium" flocculi is not quite clear.

The fact brought out by the beautiful series of photographs of Prof. Hale, that when the bright calcium flocculi are absent the bright hydrogen flocculi are present, raises a number of important points in solar physics which the spectroheliograph alone at the present time can attempt to solve.

Calcium and hydrogen are not, however, the only substances which exist in the solar atmosphere. How are the other materials distributed? The comparative thinness of the lines of these other substances in the solar spectrum makes it more difficult to analyse their distribution over the solar surface, but nevertheless possibly many of the strongest lines may yet be analysed.

It will thus be seen that the new spectroheliograph in the hands of Prof. Hale and his co-worker, Mr. Ellerman, has opened up a new field of research which apparently has no limit. The facts that the sun is continually changing in activity and that the sky in any particular place is not always clear point out that for the study of the distribution of any particular element on the disc, *one* spectroheliograph at *one* station is not sufficient. Just as in the case of sunspots, three stations, widely separated, are required to produce a nearly daily record, so with this new instrument the same number of stations would be required for the study of one element. For the complete study of several elements, it will be seen, numerous instruments will have to be employed if every advantage is to be taken immediately to begin to gather the necessary material.

So important is it that this new instrument for solar research should be employed to tell us of the changes that are taking place in the sun from day to day and from year to year, that no time should be lost in constructing a sufficient number of them, in distributing them where the raw material, sunlight, can be most often procured, and in organising a homogeneous plan of campaign.

When it is considered that a study of the solar changes is vital for the clear understanding of the numerous terrestrial variations which are so closely associated with our everyday life, the necessity of such a programme is obvious.

Just as in the case of the charting of the heavens, so this work should be of an international character, for every country would be able to reap equally the benefits which such an organisation would bring.

The Rumford spectroheliograph of the Yerkes Observatory having thus shown the exceptional value of this new method of solar research in the hands of Prof. Hale and Mr. Ellerman, future workers will find their task very much lightened by a study of this magnificent and epoch-making contribution to solar physics. It is satisfactory to note that for this work in particular among other valuable contributions to astronomy by the same author, the Royal Astronomical Society has this year awarded Prof. Hale its gold medal.

William J. S. Lockyer.

COMMEMORATION DAY AT THE UNIVERSITY OF GLASGOW.

On Tuesday, April 19, many of us were thinking of the Kelvin jubilee, which attracted the foremost scientific men of Europe here in 1896. It is only a fortnight since the body of graduates unanimously elected Lord Kelvin to be our academic chief. In 1901 the university celebrated the ninth jubilee of her own foundation. On April 19 she inaugurated an annual commemoration day.

The ceremony opened with a short religious service. After it Sir William Ramsay, who began his great career as a chemist here, discoursed on Joseph Black—the most famous chemist who has been connected with

Glasgow. Black was made professor in 1756, when he was twenty-eight, and remained here until he was translated to Edinburgh ten years later. Prof. R. Dundas Thomson wrote fiftv years ago of Black, "These two capital discoveries"—of the loss of weight when limestone is converted into quicklime, and of the disappearance of an amount of heat which does not affect the thermometer when water is converted into steam—"have been of greater service to science than perhaps any equal number of data ever pointed out by philosophers. Dr. Black was a man of elegance, modesty, and indolence. His active life in science terminated in his thirty-eighth year, for after his removal to Edinburgh, he engaged in no inquiries, and contented himself with teaching the science." Some scientific men may look back with regretful eyes to the far-off Arcadia of their great predecessor—who had two epoch-making discoveries to his credit before he was thirty-eight, and nothing but quiet though admirable teaching to do for the balance of his days. Mendeléeff at seventy, and Lord Kelvin at eighty, are still incessantly at work on the most abstruse and far-reaching problems of the intimate constitution of the world. Dr. Black's incisive critic might have remembered that it has been given to very few men of science to take an unchallenged place both among the first investigators and the most accomplished and successful teachers of his time.

Wandering, after the lecture, about the university, which our predecessors in 1870 thought to have been housed so splendidly, one finds Sir Gilbert Scott's great central building surrounded by masses of modern additions. There is a huge engineering building which cost about 30,000*l*., a botany building costing about 18,000*l*., an additional anatomy building costing about 13,000*l*., an additional surgery building costing about 10,000*l*. All these were built within the last ten years, but before the days when Dr. Carnegie stepped in like a special providence to help the Scottish universities. His benefactions are of two kinds. The first provides 50,000*l*. a year towards the payment of the fees of all students in any of the universities who ask for it and who have shown themselves qualified to profit. It was no doubt hoped that this would largely increase the number of the students, and so greatly add to the resources of the universities. The hope has hardly been realised. The number of students has not materially increased, and the universities merely receive the fees of a very large number of their students through Mr. Carnegie's trustees instead of from the parents. Many students, of course, do not ask for this benefit, but, as a very great number do, the fee money which Mr. Carnegie has provided goes, and no doubt it was to a great extent meant to go, to the relief of parents who used to pay, often, certainly, with difficulty, and it has made very little addition to the resources of the universities. It is by the second 50,000*l*. a year, destined for equipments and extensions, including buildings, that the universities have chiefly benefited. The trustees require that the university wanting new buildings for scientific teaching shall raise half the requisite money, in which case they will supply the other half. For some reason or other they have not so far helped the extensive addition—costing probably 12,000*l*.—which has just been made to the chemical department. But they are defraying half the cost of the new buildings for natural philosophy, for physiology, for medical jurisprudence and public health, and for materia medica, which are all in a state of considerable forwardness, and which will cost some 80,000*l*. The scientific world must have laboratories for practical teaching, and modern laboratories are expensive to build, and very expensive to maintain and to keep up to date. There is no more finality in scientific equipment and apparatus than in ironclads, and many things which are imperious necessities of to-day will be historic scrap iron after a dozen years. These vast laboratory extensions will be useless without great additions to the staff, and the universities will have to look not merely to the Carnegie trustees, but to the general public for further advances towards maintenance and renewal of equipment. Scientific students in Glasgow and elsewhere ought in the future to be taught more practically, but it is by no means certain that their numbers will be greatly increased. It is certain that there are many non-scientific departments which will need extensions, and cannot look to the Carnegie trustees.

I have perhaps wandered a little from the commemoration, but it is in these visible extensions actually or prospectively completed within ten years through the benevolence of Glasgow donors and the generous help of the Carnegie trustees that scientific graduates and visitors have taken the greatest interest. After their look round, they betook themselves to the Hunterian Museum, where a medallion bust of the late Prof. John Young, who was its *genius loci* for thirty-six years, was unveiled. No archæologist, numismatist, zoologist or geologist can be ignorant of his name and work. "Those who knew him best," says his life-long friend and comrade, Dr. Yellowlees, "know that they will never see another John Young."

The commemoration day is now over. It included the ceremony of conferring honorary degrees, six D.D.'s and eight LL.D.'s, including Mr. Choate, the American Ambassador, and—*in absentia*—Prof. Mendeléeff, the great Russian chemist, perhaps the foremost man in modern chemistry, and the fittest to connect the chemists of this generation with the brilliant young Glasgow professor of a century and a half ago whom the great Lavoisier was proud to acknowledge as his teacher. Mention must, however, be made of the banquet in honour of Sir William Ramsay, whose Glasgow degree is not of yesterday, and of the honorary graduates of to-day. But banquets are, after all, very much alike. W. J.

THE CELEBRATION OF SIR HENRY ROSCOE'S GRADUATION JUBILEE.

THE half-century which has elapsed since Sir Henry Roscoe graduated as doctor of philosophy at Heidelberg has been devoted by him uninterruptedly to the furtherance of science and education.

As professor of chemistry for thirty years at Owens College, he succeeded by his teaching, writings and researches in establishing a great school of chemistry, besides earning a world-wide reputation as a scientific man; as member of Parliament he assisted to lay the foundations of a scientific system of technical education; and as Vice-Chancellor of the University of London and a member of the Carnegie trust and other bodies, he has spent his later years in the organisation of scientific teaching. It was therefore fitting that at the celebration of his graduation jubilee he should be greeted by addresses from his old students and from universities, colleges, and learned societies, both at home and abroad, which bore eloquent testimony to the intense appreciation which is felt for his services to the cause of scientific and educational progress.

The ceremony took place on Friday last, April 22, at Manchester, in the Whitworth Hall of the Owens College, which, by its great architectural beauty, sets a fitting seal on the splendid group of buildings which Sir Henry Roscoe has seen grow up to replace the old house in Quay Street in which his first classes were held.

The philosophical faculty of the University of Heidelberg marked its sense of the importance of the occasion by renewing the diploma of doctor of philosophy granted half a century ago, and addresses were also presented from the Victoria University of Manchester, the old students, the universities of London, Cambridge, Liverpool, Birmingham, Edinburgh, Glasgow, Aberdeen, St. Andrews, and Montreal, University College, London, Yorkshire College, King's College, London, University College, Sheffield, Durham College of Science, University College, Dundee, Royal Society, British Association, Literary and Philosophical Society of Manchester, Chemical Society, Society of Chemical Industry, German Chemical Society, Bunsen Gesellschaft, Physikal. Verein, Frankfort, Kön. Gesellschaft, Göttingen, Pasteur Institute, Lister Institute, Owens College Chemical Society, Chemical Society of Rome, the Dutch Chemists, American Academy, American Philosophical Society, and American Chemical Society.

A large number of personal congratulations were also received from scientific men all over the world. To each of the addresses a separate reply was made, and in these concise and pointed speeches, each embodying some fresh line of thought, the audience was delighted to recognise the best possible proof of the continued mental and physical vigour of the speaker.

SIR CLEMENT LE NEVE FOSTER, F.R.S.

THE tidings of the death of Sir Clement Le Neve Foster on April 19 brought to a wide circle of friends a great shock as well as sincere sorrow, for all hoped that he might enjoy for many years the final stage of an active and honoured career. His death is a serious blow to the public service to which his life was devoted.

Born at Camberwell on March 23, 1841, he was the second son of the late Peter Le Neve Foster, who for a quarter of a century was secretary of the Society of Arts. He received his preliminary education at Boulogne-sur-Mer, and obtained his degree of Bachelor of Science of the University of France at the age of sixteen. In 1857 he entered the Royal School of Mines, and in two years achieved the remarkable distinction of securing the associateship in the mining, metallurgical and geological divisions, as well as the Duke of Cornwall's scholarship and the Edward Forbes medal. He then proceeded to the mining college of Freiberg, in Saxony, which at that time was supreme in its special field. In 1860 he received from Sir Roderick Murchison an appointment on the Geological Survey, and for five years was engaged in mapping the Wealden beds of Kent and Sussex, and the Carboniferous rocks of Derbyshire and Yorkshire.

In 1872 Le Neve Foster was appointed H.M. Inspector of Mines. The new Metalliferous Mines Regulation Act, which had just been passed, was received with a certain amount of disfavour by the Cornish miners, and the work of the first inspector was particularly difficult. The severity of which Le Neve Foster was sometimes accused bore, however, remarkable fruit. The average death rate from mine accidents in his district was reduced from 2 per 1000 during the first three years of his inspectorship to 1·3 per 1000 during the last five. In 1880 he was transferred at his own request to the North Wales district, where he remained until his retirement in 1901. His twenty-nine annual official reports afford clear evidence of the mass of work that he got through, and indicate the many ways in which the laws for the regulation of mines have been improved in consequence of his efforts. In 1890 he was, on the death of Sir Warington Smyth, appointed professor of mining at the Royal College of Science and Royal School of Mines, and continued to hold that appointment until his death. He largely improved the system of instruction, and insisted upon adequate attention being given to practical training.

He was a frequent contributor to the *Proceedings* of the many scientific societies of which he was a member, and in spite of the exigencies of his official appointments he found time for literary work. He published in 1867 a translation from the Dutch of P. van Diest's book on the tin deposits of Banca, and in 1876, with Mr. W. Galloway, he translated from the French Callon's "Lectures on Mining." He also wrote the article on mining in the "Encyclopædia Britannica." In 1894 he published his great work on "Ore and Stone Mining," the first systematic English treatise on the subject, of which the fifth edition has just been issued; and at the beginning of this year he published a smaller volume on "Mining and Quarrying," noticed in this issue of NATURE (p. 603).

In 1895 Le Neve Foster issued his first annual report upon the mineral industry. This formed an entirely new departure in official literature, and embodied the results of a vast amount of labour and technical skill in comparing the mineral industries of the United Kingdom with those of other countries. Its value was so much appreciated that his services as editor were retained by the Home Office after his retirement from the post of inspector.

Sir Clement was elected a fellow of the Royal Society in 1893. He was a juror at the Paris Exhibitions of 1867, 1878, 1889 and 1900, and was created a Knight of the Legion of Honour in 1889. He also acted as juror at the Inventions Exhibition in 1885, and at various other less important exhibitions. He served upon various departmental committees on mineral statistics, open quarries, slate mines, and explosives in mines, as well as upon the Royal Commissions for the Chicago Exhibition and for the St. Louis Exhibition. His faithful and long continued services to the public weal were officially recognised by the knighthood conferred upon him on the King's birthday last year.

No man in this, or perhaps in any other, country has rendered more conspicuous services to metalliferous mining than Le Neve Foster did. In his twenty-nine years of Government mine inspection he did much to ameliorate the lot of the miner, and by his teaching and writings he secured for metal mining, that had previously been practised mostly as an empirical art, a scientific basis.

B. H. B.

A large number of men of science attended the funeral of Sir Clement Le Neve Foster on Friday last, among them being the following representatives of scientific societies and other bodies:—Sir Norman Lockyer, president of the British Association; Sir George Armytage, Sir W. T. Lewis, and Prof. Hull, representing the Royal Commission on Coal Supplies; Prof. J. W. Judd, F.R.S., Dean of the Royal College of Science, and Mr. J. J. H. Teall, F.R.S., Director-General of the Geological Survey of the United Kingdom, representing the Royal Society; Mr. H. B. Woodward, representing the Geological Society; Mr. H. Jennings and Mr. Charles McDermid, representing the Institution of Mining and Metallurgy; Mr. Aubrey Strahan, representing His Majesty's Geological Survey, and Mr. Morant's private secretary, representing the permanent secretary of the Board of Education. The Royal College of Science and the Royal School of Mines were represented by the council and some of the students.

LORD MILNER ON SCIENCE AND INDUSTRY.

We notice with much satisfaction that Lord Milner is a statesman who recognises that scientific knowledge is essential to national progress. In a speech as honorary president of the Chemical, Metallurgical, and Mining Society of South Africa, reported in the *Rand Daily Mail*, Johannesburg, of March 28, he declared himself strongly in favour of generous expenditure upon science, and the utilisation of the services of scientific men for the development of industries. The following extracts from his address will be read with interest by all men of science :—

There is one form of expenditure which is sometimes called extravagance which is not extravagance, and that is expenditure in getting the very best scientific advice. Whatever expenditure we may curtail in the future, there is one form of expenditure which I hope we shall never curtail, and that is the expenditure upon science. And if, as I believe, in the course of a few years you find a great improvement in the agricultural conditions of this country, which means an enormous change in the economic position, greatly benefiting, among others, the mining industry, that change will have been due to the fact that from the first moment almost of ordered administration in this country after the war we sought to get the best scientific advice in all branches of agriculture in different parts of the world, a matter which does not lead to any immediate change, or to any sudden or astonishing results, but which, I believe, in course of time will be found to have been the most profitable investment possible.

The same principle applies to industry as it does to agriculture—perhaps in a higher degree you may say to industry; but then industry here always has had it from its beginning—the benefit of first-rate scientific assistance. I mean that the immediate advantages resulting from the scientific treatment of the great industry of this country have been so enormous, so obvious, that from the first moment that capital flowed into the country to develop its buried resources, the aid of science has been called in. Science in the industry has not required that Governmental support and impetus which it does require in the more neglected branches of our public economy, such as agriculture. Science has always been present in the development of the great industry of this country through the fact that the capitalists who have put their money into it have recognised from the first its supreme importance. But although private enterprise has done with relation to mining a great deal which, with regard to agriculture, for instance, only the State could do, there still remains something which the State can do even for the highly developed and highly scientific industries of this country. It can do something, and I hope it has already begun to do something.

I believe we should all agree that it is not enough that this great centre of mining industry should be able to attract, as it does, the highest ability, the highest scientific ability, from different parts of the world. We want to do something more than this; we want to grow it for ourselves. And we look forward to the time when Johannesburg will have, among other things, a mining school which shall be the first in the world, and it shall have, I hope, after that, in time, a university and a teaching university—not only confined to science—comprising science and the arts—but of which the scientific faculties will be the most eminent known to mankind. Now, you may say that is rather high-faluting and it is looking a long way ahead. It may be high-faluting, but it is my honest belief that this thing can be accomplished, and it is my intention—I am sure it is the intention of the Government, so far as our humble powers and abilities go—you know our resources at the present time are not the greatest—to do as much as we can to begin the foundations of those great institutions of the future.

This is a welcome expression of belief in the importance to the community of scientific study and organised knowledge. Only on these foundations can a country be raised from a raw state of nature to a highly-developed civilisation, or a great nation satisfy the demands of the present day.

NOTES.

A provisional programme of the meeting of the International Association of Academies, to be held in London at Whitsuntide, has been sent to the delegates appointed to attend the assembly. The following are among the arrangements announced, but they are subject to modification in detail according to the circumstances which may arise between now and the date of the meeting. On Tuesday, May 24, the commission inquiring into the anatomy of the brain will probably meet at Burlington House in the morning. In the evening the delegates will be entertained by the Royal Society at a banquet at the Whitehall Rooms. Wednesday, May 25, and the morning of the following day will be devoted to the business of the assembly. His Majesty the King has expressed his wish, if his engagements will permit, to receive the delegates, and it is hoped that arrangements may be made for this event in the afternoon of May 26. On Friday evening, May 27, the delegates are invited to a reception by the University of London; and on the afternoon of May 28 it is proposed to pay visits to the Universities of Oxford and Cambridge. On Monday, May 30, the Lord Mayor of London will entertain the delegates at a banquet at the Mansion House.

Lord Avebury has been elected president of the Society of Antiquaries; and Sir Guilford L. Molesworth has been elected to succeed Sir William White as president of the Institution of Civil Engineers.

A subcommittee has been appointed by the council of the Library Association to consider the question of the "deterioration of modern binding leathers," and to suggest a remedy. A circular is being issued to the chief libraries in the United Kingdom with the view of ascertaining, among other matters, what effective support is likely to be forthcoming from librarians in favour of leathers of the standard specified by the Society of Arts' committee.

The *Times* correspondent at Rome announces that an archæological undertaking of an important character is about to be set on foot, namely, the complete excavation of Herculaneum. It is proposed that this vast work should be carried out by the cooperation of Italy with all civilised countries, and that there should be a central managing committee in Rome with national committees elsewhere.

On Tuesday next, May 3, Mr. L. Fletcher, F.R.S., will deliver the first of three lectures at the Royal Institution on meteorites. The Friday evening discourse on May 6 will be delivered by Dr. Chalmers Mitchell on anthropoid apes, and on May 20 by Prof. Rutherford on the radiation and emanation of radium.

An International Engineering Congress, under the auspices of the American Society of Civil Engineers, will be held at the St. Louis Exposition during the week of October 3 to 8. The congress will be one of a series of international scientific congresses to be held at the exposition under the general authority and with the cooperation of the Director of Congresses.

On April 23 and 24 the Society of German Ironmasters celebrated at Düsseldorf the completion of the twenty-fifth year of its existence, and also of the twenty-fifth year of the presidency of Mr. Carl Lueg. The society is in a very flourishing condition. It numbers 2957 members, and of its journal, *Stahl-und-Eisen*, every fortnight 4900 copies are published. The meeting was well attended on both days, about eight hundred members being present.

On April 23 papers were read by Mr. Boveri, on the steam turbine, and by Mr. R. M. Daelen, on the continuous open-hearth process. On April 24 Mr. E. Schrödter traced the progress of the German iron trade during the twenty-five years of the society's existence. The announcement was then made that a gold medal had been instituted, to be called the Carl Lueg medal, and to be awarded for conspicuous services to German metallurgy. The first award was made to Mr. Lueg. Congratulatory addresses were then delivered by representatives of the Government and of numerous kindred societies. The Iron and Steel Institute was represented by a deputation of the council consisting of Mr. A. Tannett-Walker, Mr. A. Greiner, and Mr. B. H. Brough. In presenting the illuminated address from the institute, Mr. Tannett-Walker made a graceful reference to the hospitality received from the German society in 1880 and in 1902, and read a characteristic letter of congratulation sent by Mr. Carnegie.

M. de Fonvielle writes:—The fourth congress held by the International Committee of Scientific Aërostatics will be held at St. Petersburg from Monday, August 29, to Saturday, September 3. Prof. Hergesell has sent an intimation of the congress to the various delegates of France, Italy, Austria, and England. The official invitations will be sent through the Russian Foreign Office, in the name of the Imperial Academy of Sciences, which is to make arrangements for the meetings. The object of the conference, as resolved at the Berlin session, is to establish a permanent office with a regular budget paid by the various Governments, similar to the Berne bureau for telegraphy and that at Paris for meteorology. The bureau of the commission is controlling the monthly ascents which are taking place at about fourteen different stations situated in France, Germany, Russia, Austria, Switzerland, Spain, and Italy. Kite ascents are taking place at Boston and in England. The results are discussed regularly in a special publication, frequently noticed in Nature, printed at the expense of the German Government, which has spent for this purpose not less than 18,000 marks, and will continue its work up to the end of the forthcoming meeting.

The first German congress for experimental psychology was held in Giessen on April 18–21. About 130 persons accepted the invitation to attend the congress, including most of the prominent psychologists of Germany, besides physiologists, philosophers, alienists and teachers attached to various institutions, and about one hundred attended the sittings. Nearly fifty papers were read and discussed, and in order to get through this large programme the sittings were continued far into the evenings. There was an excellent exhibition of apparatus arranged by Dr. Sommer, the distinguished professor of psychiatry, who has done so much to apply the methods of experimental psychology to the investigation of mental diseases. Prof. G. E. Müller, of Göttingen, so well known for his accurate investigations of the memory, presided over the sittings, and one of the most interesting features of the congress was his demonstration and exposition of a case of exceptionally good memory. The subject, who is an intelligent and well educated man, has, in addition to a remarkable memory, principally visual in type, a power of seizing very rapidly various arithmetical relations between groups of figures presented to him, and this combination of faculties enables him to excel all the achievements of Diamanti, Inaudi, and the other "arithmetical prodigies" that have been investigated from time to time. It is proposed to institute a German association for experimental psychology for the organisation of annual congresses and of cooperative research.

Sir William White, the president of the Institution of Civil Engineers, and a number of other engineers and persons interested in the manufacture and uses of steel, paid a visit on April 20 to Hadfield's Steel Foundry at Sheffield. The object of the visit was to inspect the processes adopted and to enable the visitors to acquaint themselves with the work carried on by the Hadfield Company. The *Times* of the following day published an appreciative description of the enterprise exhibited by the company in numerous directions. In this report great prominence is given to the value placed by the Hadfield Company upon scientific laboratory research and upon experimental tests, and this part of the article in particular deserves to be read widely. As the *Times* says, "Abroad manufacturers have been quick to recognise the need for a fully staffed and equipped research department, and the amounts expended annually for this purpose in some foreign works appear almost incredible. It is only by enterprise of this nature, however, that manufacturers can keep in the van of progress, and, properly directed, this so-called 'non-productive' expenditure brings a rich reward. In Great Britain we have been somewhat apt to relegate research work to the laboratories of professors, the manufacturers devoting themselves to what are styled 'practical results.' This divorce of practice and theory does not lead to industrial success." We hope with Sir William White soon "to see the time when the example of Mr. Hadfield will be more widely followed in this country, and when inquiries, both scientific and practical, will be carried out on a very large scale in the works of manufacturers all over the country."

The Weights and Measures Committee of the Herefordshire County Council has had under consideration the Bill introduced in the House of Lords early this session to provide for the introduction of the metric system into this country. The committee does not recommend the County Council to support the Bill. The report states that the committee is of opinion that the subject is so difficult and important that it should be dealt with by the Government of the day and not by private legislation; that as it stands, the Bill does not attempt to meet the serious inconvenience and expense necessarily attendant upon the compulsory adoption throughout the country of metric weights and measures; that the decimalisation of our coinage is as important as that of our weights and measures, and that either without the other is robbed of more than half its value. At the same time the committee believes that well drawn up and well thought out measures dealing with the metric system and with the coinage, and brought in by the Government, would command the confidence of the country, go through Parliament by a large majority, and ultimately benefit both our home and foreign trade. "We lag far in the rear of all civilised nations on these questions," to quote the report, "and all that is wanted, to remove from us the stigma of marching a century behind the rest of the world, is skilful and thorough treatment of them by the Government of the day."

An address delivered by Dr. R. T. Glazebrook on April 21 as president of the Optical Society is printed in the *Optician and Photographic Trades Review*. Dr. Glazebrook pointed out that the success of German manufacturers of optical and other scientific instruments is due to the fact that the value of science as a commercial factor is more fully realised there than with us. What the Optical Society has to do in order to advance the industry which it

represents is to promote cooperation among manufacturers, technical education of opticians and standardisation, or the application of scientific methods and standards to organisation and the checking of optical work. In Germany a large proportion of recent progress is due to the stimulating and helpful influence of the Reichsanstalt. Dr. Glazebrook hoped that in a few years' time a future president of the Optical Society would be able to say, when reviewing the progress of the optical trade, that a large proportion of the advance was due to the work of the National Physical Laboratory.

The report of the Meteorological Council for the year 1902–3, recently presented to Parliament, has now been issued. The work of the Meteorological Office is briefly summarised under (1) ocean meteorology; collection and discussion of data from all parts of the ocean, and the loan of instruments to the Royal Navy and Mercantile Marine. The total number of instruments of all kinds issued during the year for the use of the Navy and Mercantile Marine was more than 1700. Barometers are also supplied to fishing stations; the total number of these instruments on loan was 229 at the end of the year in question. (2) Weather telegraphy; collection of telegraphic observations three times a day from selected stations in the British Isles and Europe, the issue of daily weather reports, weather forecasts, and storm warnings, also of special forecasts for agriculturists during hay and corn harvests (June to September). (3) Climatology; collection and publication of observations from observatories and land stations in the British Isles and British possessions. (4) Miscellaneous investigations; *e.g.* work in connection with an inquiry into London fog, and a statement of the conspicuous features of the weather during the year, including the readings of anemometers amounting to or exceeding a velocity of 44 miles per hour, corresponding to an estimated wind-force of 9 by Beaufort's scale. To this latter subject a special appendix is devoted. All the branches of the office are utilised for the preparation of replies to numerous inquiries by public bodies, newspaper reporters and private persons. The report shows greatly increased activity in all branches; special mention may be made of the supply of weekly and quarterly returns for the Registrar General's reports, and of the collection and publication of observations from foreign and colonial stations. Notwithstanding the increase of work, the funds at the disposal of the Meteorological Council remain stationary. The perusal of the report clearly shows that the useful operations of the office are to a considerable extent crippled by the want of sufficient means to carry on the work of a practically important public department on the lines followed by some of the foreign meteorological offices, and to enable it to fulfil the constantly increasing requirements of the service in this country.

In the *Bulletin de la Société d'Encouragement* M. J. Pillet presents a report on the "Little" universal drawing instrument submitted by Commander Mahon, of the U.S. Federal Army. The instrument consists essentially of two jointed parallelograms or frames, by means of which a piece called the turning plate can be shifted from one part of the diagram to another without rotation. Pivoted to this portion are two rulers at right angles, which by means of a scale of degrees can be rotated through any desired angle, and these rulers have scales by which any desired length can be measured off. The advantages of the apparatus for quickly drawing force-diagrams for engineering purposes are obvious from the illustration accompanying the paper.

Steps are being taken to promote public instruction in silk-culture on a modern scientific basis in America, and accordingly a special *Bulletin* (No. 39) has been issued by the Entomological Division on the culture and life-history of the silkworm and its moth.

A report, published at Birmingham, on injurious insects and other animals observed in the midland counties during last year has been drawn up by Mr. W. E. Collinge, of Birmingham University. It is well illustrated, and contains much valuable information for farmers and gardeners. Future annual reports are promised.

The Boston Natural History Society is preparing complete lists of the fauna of New England, of which the first part, containing the reptiles, has been issued in *Occasional Papers*. These lists are to prepare the way for a complete illustrated monograph of the fauna which the society proposes to publish.

A paper dealing with noxious insects is published in the *Boletim* of the Goeldi Museum under the title of "Os Mosquitos no Parã." The author, Prof. E. Goeldi, directs special attention to *Stegomyia fasciata* and *Culex fatigans*, and is desirous of obtaining information as to their range and habits from all parts of the country. The former species, at any rate, is believed to have been introduced from Africa. Many experiments are recorded as to the infections produced severally by these species, of which the first is diurnal and the second nocturnal.

The April number of *Bird Notes and News* contains a reference to various rare birds—including an avocet, bustards, and waxwings—which have lately visited our islands, and have mostly shared the usual fate of such wanderers. The need for effectual legal protection (if such could be devised) for rare birds of this type is emphasised, but it is pointed out that even were such birds made Crown property, as has been suggested, this would not help the case of locally rare species.

An important place was assigned at the fifteenth annual meeting of the Association of Economic Entomologists, held at Washington in December, 1902 (of which the report appears in No. 40 of the *Bulletins* of the Entomological Division of the U.S. Department of Agriculture), to a survey of the literature of the subject published in the States, and to a discussion of the best means of bringing the work of the division to the notice of those sections of the public more especially concerned. It was suggested that newspaper articles, leaflets, somewhat larger popular bulletins treating of particular species or groups of species, and larger popular monographs seemed the best means for attaining the end in view.

To the April number of the *Independent Review* Dr. A. R. Wallace contributes the first part of an article on "The Birds of Paradise in the Arabian Nights." In the introductory paragraphs the author states that he is generally disposed to believe in the truth of popular legends connected with natural history, the assertion that vipers swallow their young being a case in point. Accordingly he is predisposed to look with favour on the theory that the "Islands of Wak-Wak" mentioned in the "Arabian Nights" are really the Aru Islands, and that they take their name from "wawk-wawk," the cry of the great bird-of-paradise. The portion of the article contained in the issue before us deals only with the identification of the locality to which "the bride with the feather-dress" was brought with the south-eastern lower slopes of the Elburz Moun-

tains. We shall await with interest Dr. Wallace's proofs that "Hasan" actually visited the home of the birds-of-paradise.

Two zoologists have apparently been working synchronously and independently of one another on the same subject—the anatomy and development of *Amphilina foliacea*, the tape-worm infesting the sterlet—and the results of their investigations appear in the current issue of the *Zeitschrift fur wissenschaftliche Zoologie* (vol. lxxvi. part iii.). Both writers, Dr. L. Cohn and Dr. W. Hein, take up the subject as left by Salensky, and both are of opinion that his conclusions require emendation. Two papers on the histology and morphology of insects likewise appear in the same issue. In the one Mr. W. Plotnikow, of St. Petersburg, discusses the integument and certain peculiar structures found therein, while in the second Mr. N. Holmgren, of Stockholm, commences a series of articles dealing with the morphology of the head, commencing with that of the Chironomus larva, as displayed by the periodical moults.

We have received the March and April numbers (Nos. 3 and 4, vol. ii.) of the *Journal* of the Royal Army Medical Corps. The *Journal* is now edited by Colonel David Bruce, F.R.S., R.A.M.C., and maintains the high standard of the earlier parts. Among other articles of interest may be mentioned "para-typhoid infections," by Lieut.-Colonel Firth, R.A.M.C., cases of dum-dum fever by various writers, an illustrated description of the new Royal Army Medical College by the commandant, various clinical and editorial articles, and corps news, &c.

The report of the director (Lieut.-Colonel Semple, R.A.M.C.) of the Pasteur Institute of India (Kasauli) for the third year, ending August, 1903, has recently been issued. The inoculations for bites of rabid animals numbered 584, of which 6 were failures, a percentage of 1·02. In addition to the inoculations, experiments are in progress in order to obtain an anti-rabic serum, and the preparation of anthrax vaccine and of antivenene for snake bites has been undertaken. Various bacteriological examinations have also been carried out, the report showing that a great deal of valuable work has been accomplished. Attention is directed to the climatic difficulties that have to be surmounted, especially the liability to septic infection of the material used for the anti-rabic inoculations.

A small collection of Mycetozoa gathered in the Botanical Gardens, Tokyo, is described by Mr. A. Lister, F.R.S., and Miss Lister in the *Journal of Botany* for April. Several of the species are found in Great Britain and Europe, but one, *Erionema aureum*, which has affinities with the genus Physarum, has only been recorded once previously, and then from the Buitenzorg Gardens in Java.

Experiments conducted by Mr. M. Kanda, and recorded in the *Journal* of the College of Science, Tokyo, on the influence of very weak solutions of certain poisonous salts applied to water- and pot-cultures of flowering plants agree with the effects produced by similar salts on cryptogamic plants. A percentage appreciably less than the minimum poisonous solution in several cases stimulated the plant to accelerate its growth and increase in weight. The effect was most marked when a 5×10^{-8} gram molecule solution of zinc sulphate was added to the water-cultures.

In an account of the fibre plants which grow wild or are cultivated in the Hawaiian Islands, Mr. L. G. Blackman, of the Bernice Museum, in Honolulu, attests the value of the indigenous plant, *Touchardia latifolia*, which furnishes the fibre known as oloná. The plant is not common, and thrives best in woods at a moderate altitude. The fibre has been requisitioned for climbing ropes on account of its great tenacity. At present the cultivation of fibre yielding plants in these islands is practically limited to sisal hemp, but the writer suggests that the climate is suitable for growing *Sansevieria zeylanica*, which furnishes bow-string hemp, and *Furcraea gigantea*, the source of pita fibre.

Writing in the *Botanical Gazette* upon the morphology of the common American water-weed, *Elodea canadensis*, Mr. R. B. Wylie gives an account of the development of the floral parts, and describes the details of pollination and fertilisation. The staminate flowers are at first submerged, but owing to the accumulation of bubbles of gas in the closed flowers, they break off and rise to the surface. The pollen grains are kept afloat by the air which is held round the spines. In the pistillate flower the ovary is situated at the base of a long floral tube; the stigmas curve out well over the floral envelopes, and since they are not readily wetted, they cause a depression in the surface film of the water into which the pollen grains are drawn, and so come into contact with the stigmas.

The whole of the fourth number of vol. iv. of the *West Indian Bulletin* is devoted to information relating to Sea Island cotton in the United States and the West Indies. As the West Indian islands are considered to be specially suited for the cultivation of the Sea Island variety, the very finest and most expensive product on the market, the object of the Agricultural Department is to encourage its general introduction to the exclusion of the commoner and cheaper sorts. It is important, therefore, that the colonial cultivators should be in possession of the most trustworthy information to guide them in the re-introduction of the cotton industry. With this object in view Sir Daniel Morris, accompanied by Mr. J. R. Bovell, visited the Sea Island cotton regions of South Carolina, Georgia and Florida some months ago, and obtained, at first hand, a mass of facts bearing upon every phase of the business, from the nature of the most suitable soil to the final disposal of the cotton on the market. In addition to the report on the visit to the States, the number contains valuable notes on the various pests which injure the cotton plant in the West Indies, on the ginneries already established in the islands, on the cost of production, on the prices realised on the home markets, and so on.

A description of the topography and geology of the Baharia Oasis, in the Libyan desert, has been prepared by Dr. John Ball and Mr. H. J. L. Beadnell (Survey Department, Public Works Ministry, Cairo, 1903). This oasis is a large natural excavation in the great Libyan plateau, and is entirely surrounded by escarpments of Upper Cretaceous limestones and sandstones, with thin cappings of Nummulitic limestone (Eocene). The grey limestone and white chalk of the Danian form the prominent upper scarps, while the oldest strata are represented by the Nubian sandstone, partly Cenomanian and partly Senonian. The greatest length of the oasis is 94 kilometres, and its greatest width about 42 kilometres. Within the excavated area there are many isolated hills, some capped by white limestone, others by (? Oligocene) dolerite and ferruginous quartzites. The lowest part of the oasis is 113 metres above sea-level, and the floor consists of sandstones and clays strewn with rock fragments. There the springs occur and also the villages.

Partially dried salt areas are to be observed, with glittering incrustations of salt, and sand-dunes likewise diversify the scene. The authors give details of the stratigraphy and palæontology. They note that the Danian is overlain unconformably by the Eocene, between which disturbances with faulting and denudation took place. In post-Eocene times there were further earth movements accompanied by the igneous intrusions. It is not clear, however, whether these disturbances were prior or subsequent to the deposition of the ferruginous quartzites. These latter were formed in a slight depression of the Eocene and Cretaceous rocks before the great erosion of the oasis. The authors remark that the agent of denudation cannot be stated with certainty. The effects of the disturbances had weakened the rocks, and the main erosion was carried out in the moist climate which existed in Egypt in Pliocene and early Pleistocene times, and is being continued to-day by the powerful agency of the desert wind-borne sand and changes of temperature.

A fifth edition of Mr. W. Jerome Harrison's "Text-book of Geology" has been published by Messrs. Blackie and Son, Ltd. The book has been revised and brought up to date, and many new illustrations have been used to embellish its pages.

Messrs. Whittaker and Co. have published the *School Calendar* for 1904. It is a convenient and useful guide to the scholarships offered by the universities, public schools, and other educational institutions. Full particulars of the public examinations to be held during the current year are also given.

The April number of *Cassell's Magazine* opens with a well illustrated description of the Royal Botanic Gardens at Kew, written by Mr. Richard Davey. An illustrated article on radium and its possibilities, by Dr. Louis Elkind, is also included in the same issue.

Mr. J. W. Jarvis, St. Mark's College, Chelsea, S.W., has undertaken the duties of secretary and treasurer of the London Geological Field Class. The excursions this season are to Merstham on April 30, and to Purley, Henley, Wimbledon, Aylesford, Leighton, Bedford, and Chislehurst on succeeding Saturdays.

The Department of Agriculture and Technical Instruction for Ireland has published the second *Bulletin* in its science and art series. The pamphlet deals with the spectrometer: its construction, adjustments, and uses, and is written by Mr. W. J. Lyons, of the Royal College of Science for Ireland.

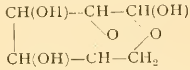
We have received a copy of the *Chemisch Weekblad*, a new weekly publication of the Dutch Chemical Society, under the editorship of Dr. L. T. Reicher and Dr. W. P. Jorissen.

A prize of 1200 marks is offered by Prof. J. H. van 't Hoff for the collection and systematic arrangement of all the literature bearing upon catalytic phenomena. Competitors for the prize are required to send in their manuscripts before June 30, 1905, to the Redaktion der *Zeitschrift fur physikalische Chemie*, Leipzig, Linnéstrasse 2. The award will be decided by Profs. van 't Hoff, Arrhenius and Ostwald.

In the *Journal of Physical Chemistry* Miss Clara C. Benson directs attention to an interesting reaction, the rate of which is diminished by raising the temperature. The reaction in question is the liberation of iodine from potassium iodide by chromic acid in presence of ferrous sulphate. The only reactions previously studied which have a negative temperature coefficient appear to be those in which a colloidal catalytic agent is involved, and the decrease of velocity with rise of temperature is in these cases probably due to the coagulation of the colloid.

The mode of action of the oxides of nitrogen in the oxidation of sulphur dioxide in the lead chamber process is discussed in a detailed manner and from a physico-chemical standpoint by Dr. Trautz in the current number of the *Zeitschrift für physikalische Chemie*. It is pointed out that although the theories of Lunge and of Raschig throw considerable light on the reactions involved, yet the problem can by no means be regarded as solved. According to the author's experiments the essential reactions involved in the lead chamber process all take place with such large velocities that their nature cannot be determined with the aid of modern criteria.

In the *Zeitschrift fur Farben- und Textil-Chemie*, vol. iii. p. 97, Prof. A. G. Green discusses the question of the constitution of cellulose. It is pointed out that the grounds for the assumption that cellulose must have a large molecular weight are insufficient, and the simple formula $C_6H_{10}O_5$ seems more probable. As representing the constitution of this important body, the formula



is suggested. According to this, cellulose is an inner anhydride of glycose, and the formation of the latter on hydrolysis is thus easily explained. The formula, moreover, accounts for all the principal reactions, for the formation of the trinitrate and triacetate, for the production of ω-bromo-methylfurfurol by action of hydrobromic acid, and also explains its latent aldehyde character.

The additions to the Zoological Society's Gardens during the past week include two Cheetahs (*Cynaelurus jubatus*) from Africa, presented by Colonel B. Mahon, C.B., D.S.O.; a Lesser Black-backed Gull (*Larus fuscus*), European; a Royal Python (*Python regius*) from West Africa, presented by Mr. E. W. Wildeblood; a Goshawk (*Astur palumbarius*), European, presented by Major-General Kinloch; two Roseate Cockatoos (*Cacatua roseicapilla*) from Australia, presented by Mr. T. J. Kynnersley; a Western Slender-billed Cockatoo (*Licmetis pastinator*) from Western Australia, presented by Miss Newbold; four Moorish Geckos (*Tarentola mauritanica*) from North Africa, five European Tree Frogs (*Hyla arborea*), a Common Toad (*Bufo vulgaris*), European, presented by Mr. F. M. Davis; four Common Vipers (*Vipera berus*), European, presented by Mr. G. E. Bon Bernais; a Suricate (*Suricata tetradactyla*) from South Africa, four Crowned Cranes (*Balearica pavonina*) from West Africa, a Greater Sulphur-crested Cockatoo (*Cacatua galerita*) from Australia, three Madagascar Porphyrios (*Porphyrio madagascariensis*) from Madagascar, two Antarctic Skuas (*Stercorarius antarcticus*) from Antarctic Seas, two Yellow-vented Parrakeets (*Psephotus xanthorrhous*) from Australia, deposited; two Natal Duikers (*Cephalophus natalensis*) from South-east Africa, five Rose-coloured Pastors (*Pastor roseus*) from India, purchased; five Fat-tailed Desert Mice (*Pachuromys depresi*), born in the Gardens.

OUR ASTRONOMICAL COLUMN.

Astronomical Occurrences in May:—

May 1–6. Epoch of Aquarid meteoric shower (Radiant $338° - 2°$.)

2. 16h. 50m. Inferior conjunction of Jupiter's Sat. IV. (Callisto).

9. Neptune 10′ south of μ Geminorum (Mag. 3·2).

,, Saturn. Major axis of outer ring = 38″·98, minor axis = 9″·09.

12. 1h. Moon in conjunction with Jupiter. Jupiter 0° 44′ N.

15. Venus. Illuminated portion of disc = 0·969, of Mars = 0·999.

16. Pallas in opposition to the Sun (Pallas Mag. 8).

20. 10h. 52m. Minimum of Algol (β Persei).

21. 9h. 1m. to 9h. 26m. Moon occults o Leonis (Mag. 3·8).

30. 6h. Mars in conjunction with the Sun.

Comet 1904 *a*.—*Circular* No. 65 from the Kiel Centralstelle contains a telegram received from Prof. Pickering, who announces that the comet 1904 *a* was photographed at Harvard on March 11 and 15, and April 1, 5, 13 and 16, and also gives the coordinates for those dates. He further gives the following set of elliptic elements, and an ephemeris, calculated by Messrs. Curtiss, Albrecht, and Leuschner from observations made on April 17, 18 and 19:—

Epoch 1904 *April* 18·62 *Greenwich*.

$$M = 159° \, 8' \qquad q = 1·7177$$
$$\omega = 258 \; 57 \qquad e = 0·1773$$
$$\Omega = 272 \; 13 \qquad U = 3^{y}·02$$
$$i = 126 \; 39$$

Ephemeris 12*h*. *G.M.T.*

1904		α h. m. s.		δ ° ′		Brightness
April 21	...	16 44 32	...	47 13	...	0·98
25	...	16 31 8	...	49 30		
29	...	16 16 8	..	51 34		
May 3	...	15 59 44	..	53 22	...	0·88

The comet was observed on April 19 and 20 by Herren Wirtz and Becker respectively, who determined the following positions:—

	M.T. (Strassburg) h. m.		α ° ′ ″		δ ° ′ ″		Mag.
April 19 ...	9 11·3	...	252 44 56	...	45 55 13	...	9·1
20 ...	11 37·4	...	251 56 1	...	46 35 38	...	9·3

Elements and Ephemeris for Wolf's Comet (1884 III.).—The following elements for Wolf's comet (1884 III.), corrected for the planetary perturbations up to the epoch June 12, 1904, are given by Herr A. Berberich in No. 3940 of the *Astronomische Nachrichten*:—

Epoch 1904 *June* 12·0 *Berlin*.

$$M = 312° \; 52' \; 22''·66$$
$$\left.\begin{array}{l} \omega = 172 \; 50 \; 38·22 \\ \Omega = 206 \; 28 \; 59·66 \\ i = 25 \; 14 \; 40·20 \end{array}\right\} 1900·0$$
$$\phi = 33 \; 48 \; 59·19$$
$$\mu = 520''·05191$$
$$\log a = 0·5559733$$

An ephemeris for the period May 7–August 11, 1904, from which the following is an extract, is also given:—

Ephemeris 12*h*. (*M.T. Berlin*).

1904		α h. m. s.	δ ° ′	log *r*	log Δ	Brightness
May 7	...	18 2 21	+2 50·9	0·5298	0·4223	0·012
11	...	18 1 1	+3 27·8			
15	...	17 59 21	+4 4·2	0·5243	0·4044	0·014
19	...	17 57 23	+4 39·7			
23	...	17 55 7	+5 13·9	0·5186	0·3881	0·015
27	...	17 52 35	+5 46·6			
31	...	17 49 48	+6 17·4	0·5128	0·3739	0·017

Stars having Peculiar Spectra.—In *Circular* No. 76 of the Harvard College Observatory, Prof. Pickering gives a list of stars which have been found, on the Henry Draper Memorial photographs, to possess peculiar spectra. The present list contains the designation, the coordinates, the magnitude and the nature of the spectrum peculiarity of twenty-two stars, and is supplementary to the similar lists previously published.

Circulars No. 77 and No. 78 have also been received. The first is a supplement to the "Provisional Catalogue of Variable Stars" published in vol. xlviii. of the Harvard College Observatory *Annals*; the second deals with the variable stars in the nebula of Orion, and in many cases confirms Dr. Max Wolf's conclusions respecting the variability of a number of the stars published in Dr. Bond's discussion of the nebula, which appeared in vol. v. of the Harvard College Observatory *Annals*.

Spectra Obtained from the Wehnelt Interrupter Discharge.—Mr. H. W. Morse, of the Jefferson Physical Laboratory, Harvard University, has obtained the spectra of a number of elements, using as the light source the brilliant glow which surrounds the "active" electrode of a Wehnelt interrupter when the current is passing. He hoped to obtain, among other results, some indications, from the nature of the spectra, that the temperature of this glow was intermediate between that of the flame and arc, or arc and spark, and thereby to provide another definite step in the laboratory temperature scale. From the spectra obtained, however, it appears that the environment of the electrode passes through a very great range of temperature with each interruption of the current, for under the same constant experimental conditions the strongest lines of the condensed spark appeared at the same time as lines usually attributed to the flame. Usually the "Wehnelt" spectrum is closely allied to that of the spark, but often some of the strongest lines are missing.

Mr. Morse discusses in detail the results obtained for each of the thirteen elements he used, and in a series of tables gives the wave-length of each line obtained, together with the relative intensity of the line in the arc, spark, and "Wehnelt" spectra respectively. A number of reproductions of the spectra obtained also accompany the paper, which is published in No. 3, vol. xix., of the *Astrophysical Journal*.

Variable Stars of the Orion Nebula.—Prof. Ernst Hartwig, in a communication to No. 3936 of the *Astronomische Nachrichten*, gives a list of corrections to the "Chart of Stars in the Nebula of Orion" which was published in vol. v. of the Harvard College Observatory *Annals*. The corrections have been obtained from observations made by Dr. Max Wolf and from the measurement of a photograph taken by Prof. Scheiner, and are given in tabular form for the equator of 1857.

THE GERMAN ANTARCTIC EXPEDITION.[1]

The German South Polar Expedition was absent altogether twenty-eight months, of which fourteen months were passed in the south polar ice, ten months with our operations in the South Atlantic and South Indian oceans, and four months with our work and residence in the islands of the Indian and Atlantic Oceans and at the Cape.

After leaving Cape Town on December 7, 1901, a successful series of soundings and investigations was carried on between there and Kerguelen, and further on as far as the fringe of ice. Amongst the results, I lay stress on the demonstration of a trough more than 4500 metres deep, running between the Crozet Islands and Kerguelen, and connecting the abysses of the Indian Ocean with a deep ravine on the outer edge of the Austral Glacial sea.

The results of the expedition cannot be comprehensively surveyed until the whole material and the copious collections, all of which have been brought back in good condition, are worked up and made accessible. It may, however, be already affirmed that the *Gauss* Expedition achieved everything in the region assigned to it that it was possible to achieve in the time available. It discovered a new land, and thereby cleared up an old contested question regarding the nature and extent of the Antarctic continent

[1] Abridged from a paper by Dr. Erich von Drygalski read before the Royal Geographical Society on April 25.

for more than ten degrees of longitude, certainly for about half the debated region between Knox and Kemp's Lands, and perhaps for the whole. At least, for the actual determination of the westerly tract, observations are now at hand by which light may be shed on the specified question. An important factor is the steep fall of the land down to a deep sea discovered by us; important, also, is the structure of the land, which consists of old crystalline rocks; lastly, it is important to find that this margin of the continent is occupied by a volcanic formation the lavas of which contain molten gneisses which have been forced up with them from the bed-rock.

The inland ice covering the continent presents a picture of our former Ice age, and is undoubtedly the vastest Glacial area now existing. Yet it was still more extensive in former times, as shown by traces on the Gaussberg.

To this continent we directed our operations, and endeavoured to study all the phenomena presented by it. In the biological field, these studies ranged with Prof. Dr. Vanhöffen from the large marine mammals and the flocks of rare birds on the seaboard, through the numerous species of the smaller marine fauna to the bacteria which Dr. Gazert was able to detect, if not in the Glacial sea itself, at least in its organisms, as well as in the rookeries of the stormy petrels on the Gaussberg, and in its few lichens and mosses. On the physical side, our observations extended from Dr. Philippi's studies of the Gaussberg lavas and of the continental boulders borne to great distances by the ice, through the numerous properties of the Glacial sea and of the Glacial formations by myself, up to determinations of the force of gravity, and to Dr. Bidlingmaier's determinations of the most delicate oscillations of the terrestrial magnetic forces, both in their normal periodicity and in their stormy perturbations, such as are displayed especially during the appearance of the southern auroras.

But should anyone doubt that we there lived and worked in a new region on the fringe of the south polar continent, conviction will be afforded by the climate. In the north we left behind us the zone of west winds and crossed a trough of low barometric pressure, remaining on its southern slope, where the pressure again rises to a maximum over the continent. Hence the prevalence of the easterly winds, which sweep down from the south over the vast uniform and but slightly inclined surfaces of the inland ice, and appear on the seaboard as easterly, Föhn-like gales.

These gales impart to the south polar region its character and its limits; by their frequency and uniformity they reveal the immensity and the homogeneous nature of those Antarctic lands. Their northern confines may have some importance for practical navigation whenever there is a question of circumnavigating the zone of the Austral west winds.

EDUCATION IN INDIA.

The promulgation of an elaborate and comprehensive State document by the Home Department of India, already referred to in Nature (April 7, p. 550), exhaustively reviewing the subject of education in all its branches and laying down the policy adopted by the Government in regard to each, and the recent passing of the Universities Act in the Viceroy's Legislative Council in India, naturally direct attention to the efforts being made in the Indian part of our Empire to place every grade of education upon a satisfactory basis. The various stages in the agitation which preceded the adoption of the Universities Bill by the Legislative Council have already been referred to on several occasions in these columns. In the following brief summary of the distinguishing characters of each of these efforts to advance education in India, continual reference has been made to the columns of the *Pioneer Mail* of Allahabad.

First to deal with the official minute with which Lord Curzon is naturally conspicuously associated. We find the system of public instruction in India includes five universities, those of Calcutta, Bombay, Madras, the Punjab, and Allahabad, which prescribe courses of study and examine the students of affiliated colleges. These colleges are widely scattered throughout the country, and number in all 191 (exclusive of some colleges outside British India, which are not incorporated in the provincial statistics), with 23,000 students on the rolls. In them provision is made for studies in arts and Oriental learning, and for professional courses of law, medicine, engineering, teaching and agriculture. Below the colleges are secondary schools, to the number of 5493, with an attendance of 558,378 scholars, and primary schools numbering 98,538, with 3,268,726 pupils. Including private institutions, there are about $4\frac{1}{2}$ million scholars, maintained at a cost of 400 lakhs, of which nearly one-half is derived from public funds. The total grants from public funds fall short of 1,300,000*l.* a year, and the extension and improvement of education in India are chiefly a matter of increased expenditure.

In India, far more than in England, the majority of students who frequent the higher schools and the universities are there for the purpose of qualifying themselves to earn an independent livelihood; Government service is regarded by the educated classes as the most assured, the most dignified, and the most attractive of all careers. It is, however, justly complained by competent authorities that higher education is too much pursued with a view to Government service, that excessive prominence is given to examinations, that studies are too literary in character, that the memory is trained rather than the intelligence, and that in the pursuit of English education the vernaculars are neglected, and so fail to become the vehicles for the diffusion of western knowledge among the masses. But it is clear from the minute that the Government of India holds that the multiplication of competitive tests for Government service neither results in advantage to Government nor is consistent with the highest interests of a liberal education. In fixing the educational standards which qualify for appointments, it is stated that the natural divisions of primary, secondary, and university education should be followed. School and college certificates of proficiency should, so far as possible, be accepted as full evidence of educational qualifications, and due weight should be attached to the recorded opinions of collegiate and school authorities regarding the proficiency and conduct of candidates during their period of tuition. The questions as to what subjects should be taught and by what means proficiency in them should be tested are considered as a part of the larger problem of the true object of secondary education. The Government of India thinks that the solution of the difficulty will be found in adapting to Indian conditions the system of leaving examinations, held at the conclusion of the secondary course, which has been tried with success in other countries.

Referring to technical education, the minute points out that the first call for fresh effort is toward the development of Indian industries. Technical instruction directed to this object must rest upon the basis of a preliminary general education of a practical kind, which should, as a rule, be imparted in schools of the ordinary type. In fixing the aim of the technical schools, the expansion of the existing Indian markets is of superior importance to the creation of new export trades. As a step towards providing men qualified to take a leading part in the improvement of Indian industries, the Government of India has determined to give assistance in the form of scholarships to selected students to enable them to pursue a course of technical education under supervision in Europe or America. The Government hopes that the technical schools of India may in time produce a regular supply of young men qualified to take advantage of such facilities, and that the goodwill and interest of the commercial community may be enlisted in the selection of industries to be studied, in finding the most suitable students for foreign training, and in turning their attainments to practical account upon their return.

Agricultural education in India is then passed in review. India possesses no institution capable of imparting a complete agricultural education. The existing schools and colleges have neither produced scientific experts nor succeeded in attracting members of the land-holding classes to qualify themselves as practical agriculturists. Both of these defects must be supplied before any real progress can be expected. In the first place an organisation must be created by which men qualified to carry on the work of research, and to raise the standard of teaching, can be trained in India itself. The Government of India has therefore under its consideration a scheme for the establishment

of an Imperial Agricultural College in connection with an Experimental Farm and Research Laboratory, to be carried on under the general direction of the Inspector-General of Agriculture, at which it is intended to provide a thorough training in all branches of agricultural science, combined with constant practice in farming work and estate management (see p. 564). There will be courses of instruction extending to five years, which will qualify men to fill posts in the Department of Agriculture itself, such as those of assistant directors, research experts, superintendents of farms, professors, teachers, and managers of encumbered estates.

In conclusion the Governor-General in Council states in the minute that the system of education thus extended makes provision in varying degrees for all forms of intellectual activity that appeal to a civilised community. It seeks to satisfy the aspirations of students in the domains of learning and research; it supplies the Government with a succession of upright and intelligent public servants; it trains workers in every branch of commercial enterprise that has made good its footing in India; it attempts to develop the resources of the country and to stimulate and improve indigenous arts and industries; it offers to all classes of society a training suited to their position in life; and for these ends it is organised on lines which admit of indefinite expansion as the demand for education grows and public funds or private liberality afford a larger measure of support. It rests with the people themselves to make a wise use of the opportunities that are offered to them, and to realise that education in the true sense means something more than the acquisition of so much positive knowledge, something higher than the mere passing of examinations, that it aims at the progressive and orderly development of all the faculties of the mind, that it should form character and teach right conduct—that it is, in fact, a preparation for the business of life.

The aspirations of the Government of India, so far as university education in particular is concerned, may be gathered both from the minute already referred to and from the Viceroy's speech at the meeting of his Legislative Council on the occasion of the passing of the Universities Act. The minute points out that it has been realised in India that universities which are merely examining bodies tend to accentuate the defects of the Indian intellect—the disproportionate development of the memory and the incapacity to observe and appreciate facts. It is proposed to reconstitute the unwieldy senates of the universities, and to define and regulate the position and powers of the syndicates. The universities are to be empowered to provide teaching, while collegiate teaching will be tested by inspection in addition to examination, and a higher educational standard will be enforced from collegiate colleges. Government is prepared to afford liberal financial aid to enable universities to adapt themselves to the new conditions, and it is hoped that such aid may stimulate private beneficence.

Lord Curzon, in his speech to the Legislative Council, said that the fact that the Government had taken the power of the last word in the entire programme of reconstruction of Indian universities is the best guarantee that the programme will not be inoperative, though he regretted that the Government is compelled to be so dominant a factor in the settlement of Indian problems. But, he continued, if the Government had not taken up this particular problem of higher education, who would have done it? and if the Government had not made itself responsible for seeing it through, who could give any guarantee that it would not have proved abortive? It is quite likely, said the Viceroy later, that the senates and syndicates of the universities of India will be perfectly competent to stand by themselves and will make no mistakes, but if not, and until they are created, the matter must necessarily be in doubt, and the Government must, in common prudence, retain the power.

It is consequently clear enough that the improvement of education in India in the immediate future is now fully assured, and it may be expected with confidence that the result of this development will in our eastern empire be identical with that in other countries, viz. an increased prosperity and national well-being.

PLATING UPON ALUMINIUM.

MANY attempts to plate other metals upon aluminium have been tried, but although apparent success has—for a short time—attended some of these efforts, the film of metal plated on has not been of such a nature as to stand wear or rough usage. Messrs. C. F. Burgess and Carl Hambuechen publish a new method in the March number of *Electrochemical Industry*. The difficulty of plating on aluminium is generally, and probably correctly, attributed to the invisible film which forms upon that metal when exposed to air. Therefore most of the methods previously described depend upon the removal (or attempted removal) of this film by means of solvents, such as acids or alkaline hydroxides, and the rapid transference from the pickling to the plating bath.

An ideal method would be to plate in a bath containing some substance which would dissolve off the film of oxide from the aluminium and thus leave it clean for the deposition of the metallic film. Messrs. Burgess and Hambuechen find that the presence in the bath of soluble fluorides, such as sodium or ammonium fluoride, or preferably a small quantity of free hydrofluoric acid, dissolve off or prevent this film formation.

The next important point is to plate as a base metal, upon the aluminium, one which will adhere tenaciously to its surface, or partially alloy with it. Zinc appears to possess this property of adhesion to a high degree.

The method of procedure is first to clean the aluminium by immersion for a few minutes in a bath of hydrofluoric acid; this produces a suitable roughening of the surface; the adhesion to a perfectly polished surface is not satisfactory. On removal from this bath the aluminium is rinsed in running water, dipped for a few seconds in a bath consisting of a mixture of sulphuric acid 100 parts and nitric acid 75 parts, again rinsed in water, and placed in the plating bath.

The plating bath consists of a mixture of zinc and aluminium sulphates, which is very slightly acidified, and contains about 1 per cent. of hydrofluoric acid and an equivalent amount of potassium fluoride. After the deposition has continued for a few minutes with a current density of 10 to 20 amperes per square foot the article is taken from the bath, washed and dried. Other metals, such as copper or silver, may now be deposited upon the zinc coating, using the ordinary precautions commonly observed in the deposition of such metals upon zinc.

If gold is to be deposited upon it, it is necessary first to plate on a thin coating of copper, otherwise in a short time the gold sinks into the zinc and in a few weeks almost disappears.

The authors do not state whether aluminium coated with zinc can be readily soldered, but probably there would be no difficulty in doing this. F. M. P.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

WE learn from *Science* that Mr. John D. Rockefeller has given 100,000*l.* to the Johns Hopkins Hospital, in order that the work of the institution may not be curtailed owing to the losses from the recent Baltimore fire. The Maryland Legislature has voted 5000*l.* annually for two years to the Johns Hopkins University. By the will of Mrs. Farnham, widow of the late Prof. Henry Farnham, Yale University receives 10,500*l.* for the endowment fund of the medical school and 7900*l.* for the endowment fund for the library.

IT is announced in *Science* that the Assembly has passed a Bill appropriating 50,000*l.* for the New York State College of Agriculture at Cornell University; that President C. E. Miller, of Heidelberg University, Tiffin, Ohio, has secured pledges to the amount of 30,000*l.* for the fuller equipment of this university, 10,000*l.* of this amount to be expended in buildings, and 20,000*l.* to be added to the permanent endowment; and that Mr. Andrew Carnegie has given 6000*l.* to Berea College in Kentucky.

AT a recent meeting of the New York section of the American Chemical Society a discussion on the training

of technical chemists was opened with a paper by Mr. J. B. F. Herreshoff. The paper insists that before deciding on the best methods of training technical chemists, it must be seen that they are sufficiently educated on the proper lines to enable them readily to become technical chemists of great value. To achieve the greatest success in such work a technical chemist should perfect his mathematics and become thoroughly familiar with physics as well as with mechanical engineering. After men have gone through a regular course in chemical engineering they should be trained before leaving college in a practical manner in the application of chemistry as well as in examples of engineering problems. Later, the paper lays it down that to become a skilful investigator in a research chemical laboratory requires both a proper education at college as a chemical engineer, especially full in chemistry, and also a training at college in original thought as applied to practical investigation, and to working up and improving processes. Applied chemistry would be greatly benefited if colleges would come in closer touch with the manufacturer. A plan that has been in successful practice at Brown University for the last few years was then described. A separate committee for each department of study is carefully selected from the old students. These committees visit the college once or more a year; they consult and exchange views with the heads of the departments. Each member reports his recommendations to the chairman of his committee, who incorporates the same in his report to the president of the college. In this way the college authorities are kept in close touch with modern technical requirements.

SOCIETIES AND ACADEMIES.

LONDON.

Zoological Society, April 19.—Dr. Henry Woodward, F.R.S., vice-president, in the chair.—Mammals obtained by the late Mr. W. G. Doggett on the Anglo-German Boundary Commission: Oldfield **Thomas**, F.R.S., and Harold **Schwann.** Twenty-one species were enumerated, of which three were described as new.—Contributions to the anatomy of the Lacertilia, ii.: F. E. **Beddard**, F.R.S. The present part dealt with some points in the structure of the Teguexin (Tupinambis).—The Triassic reptile *Telerpeton elginense*, based on new material recently procured at Lossiemouth by Mr. William Taylor: G. A. **Boulenger**, F.R.S.—Descriptions of twenty-three new species of butterflies belonging to the family Erycinidæ, from tropical South America: Herbert **Druce.**—The theriodont mandible and its mode of articulation with the skull: Dr. Robert **Broom.**

Royal Meteorological Society, April 20.—Captain D. Wilson-Barker, president, in the chair.—The variation of the population of India compared with the variation of rainfall in the decennium 1891–1901: W. L. **Dallas.** The author showed that during the four years 1891–5, the rainfall was generally normal or heavy over nearly the whole country, and during the six years 1895–1901 the rainfall was greatly deficient. During the former, or "wet" period, the rainfall was deficient over Upper Burma and Madras, was normal over the remainder of Burma, Assam, Bengal, and the west coast of the peninsula, and was excessive elsewhere; while during the latter, or "dry," period, the rainfall was again deficient over Upper Burma, normal or excessive over the remainder of Burma, Assam, Bengal, the United Provinces, the North-west Frontier Province, and the south of Madras, and was deficient elsewhere, mostly so over Rajputana and neighbouring areas. The general census of India on March 1, 1901, showed the total population to be 293,475,477, which, excluding the territories not included in the 1891 census, was an increase of only 1·3 per cent. The population had thus failed to increase according to the normal rate during the decade. Part of this failure was, no doubt, due to epidemics. The author, however, shows that there is an unmistakable relationship between the variations of the population and the variations of rainfall during the dry years. The area within which the most serious decrease of population occurred coincides almost exactly with the area of greatest deficiency of rainfall.—The cause of autumn mists: Dr. J. B. **Cohen.** The author describes experiments made by him on Coniston Lake some time ago.

DUBLIN.

Royal Irish Academy, April 25.—Prof. Atkinson, president, in the chair.—The secretary read a paper by Dr. J. L. E. **Dreyer** containing the results of a survey of the great spiral nebula Messier 33 in the constellation Triangulum; 431 stars and nebulous points of condensation found on a photographic negative taken by Dr. Isaac Roberts were micrometrically measured, and their standard coordinates computed.

PARIS.

Academy of Sciences, April 18.—M. Mascart in the chair.—On the horistic method of Gylden: H. **Poincaré.** In a work on the series employed in the theory of planets, Gylden has expounded two methods which he entitles horistic. The first of these has been shown to be open to grave objections, and in the present paper the second is examined, with the result that it is found to give not the general solution, but a particular solution, which the author calls a periodic solution. It differs numerically from the solution given by Gylden.—On the presence of argon in the gas from the fumerolles at Guadeloupe: H. **Moissan.** The gases were collected under conditions which precluded the possibility of any contamination by any atmospheric air, and proved on analysis to consist chiefly of carbon dioxide and nitrogen, together with small quantities of sulphuretted hydrogen, oxygen, and argon. This latter gas has been found in all samples of gases from fumerolles which have been analysed by the author up to the present.—The action of silicon upon water at a temperature near 100° C.: H. **Moissan** and F. **Siemens.** By the prolonged action of water at about 95° C. upon silicon, either crystalline or amorphous, a small quantity of hydrogen is evolved, and each particle of silicon is surrounded by a coating of hydrated silica. This effect was shown to be due to the minute amount of alkali dissolved from the glass, since it was stopped by the presence of a small quantity of acid, and no such effect could be observed in vessels of platinum or of fused silica.—On a new entire function: G. **Mittag-Leffler.**—Permanent modifications. On the properties of systems affected with both hysteresis and viscosity: P. **Duhem.** The influence of lateral pressures on the resistance of solids to crushing: M. **Considère.** The crushing resistance of cement is increased by lateral pressure on the specimen. The curves given in the paper show that there is a linear relation between the crushing resistance and the external pressure on the sides of the test piece.—On certain ordinary differential equations of the second order: S. **Bernstein.**—On a series analogous to modular functions: M. **Lerch.**—On the theory of systems of differential equations: L. **Schlesinger.**—On the compensation of interferences and the measurement of small thicknesses: Georges **Meslin.** The retardation due to a thin isotropic plate is balanced by the retardation due to the rotatory polarisation of quartz. In this way a thickness of air of the order of 0·01 mm. is balanced by a piece of quartz several centimetres in thickness. The great sensitiveness of the method lends itself to the determination of the optical properties of crystalline bodies which can only be obtained in the form of thin plates.—On the spectrum of zinc: Maurice **Hamy.** The interference method has been recently subjected to criticism; the author has re-determined some of the wave-lengths of the principal rays of zinc, and shows that they are in absolute accord with the results of Perot and Fabry.—On some bodies acting on the photographic plate: Edmond **van Aubel.** A description of experiments with resin giving results analogous with those of Russell and Graetz on hydrogen peroxide and turpentine.—The action of the Hertzian oscillations on faintly luminous objects: C. **Gutton.** The action of the Hertzian waves is similar to that of the *n*-rays.—On a system of damping: MM. **Favé** and **Carpentier.** A system of very fine wires or glass capillary tubes is arranged radially round the moving needle, the damping effect being produced by the viscosity of the air. The

resistance to motion has been worked out experimentally as a function of the diameter of the wire, and the results compared with the theory of Stokes.—On the apparent diminution of energy of a feeble acid in the presence of its neutral salt: G. **Chesneau.** The incomplete precipitation of metallic acetates in the presence of sodium acetate by means of hydrogen sulphide appears to be due to the formation of small quantities of an alkaline sulphide, and it is unnecessary to resort to the electrolytic theory of dissociation to interpret this phenomenon.—On the methyl ether of acetol: Louis **Henry.**—On the acetolate of methyl: André **Kling.**—Halogen ether oxides, $RO(CH_2)_nX$, and their magnesium compounds. New syntheses in the tetramethylene series: J. **Hamonet.**—On a new general reaction of aldehydes: L. J. **Simon** and A. **Conduché.** Aldehydes condense with oxalacetic ester and ammonia to give crystalline compounds, the constitution of which is not yet completely made out.—The chlorination of phenyl carbonate in the presence of antimony chloride: Et. **Barral.**—The action of sulphur and selenium on the organomagnesium compounds of aromatic hydrocarbons, with one or two halogen atoms in the ring: F. **Taboury.** Sulphur gives thiophenols and disulphides; selenium forms analogous compounds.—The purification and characterisation of alcohols: L. **Bouveault.** Pyruvic esters are readily formed, and give characteristic semicarbazones.—On two isomeric β-methylcinnamic acids: M. **Tiffenau.**—The action of organomagnesium compounds on phthalimide and phenylphthalimide: Constantin **Reis.**—On the hydrates of methyl alcohol and acetone: E. **Varenne** and L. **Godefroy.** The existence of several hydrates of methyl alcohol and acetone is inferred from a study of the viscosity of various mixtures of these substances with water.—On the perception of luminous radiations in nocturnal moths, and on the use of lamps as decoys: Joseph **Perraud.**—On the peduncle of some Vorticellæ: Emmanuel **Fauré.**—On the presence of a new American genus (Abronia) in the Tertiary flora of Europe: L. **Laurent.**—On the sulphur spring of Matsesta (Transcaucasia) and the relation between caves and thermo-mineral springs: E. A. **Martel.**—The histology and bacteriology of mud extracted from a depth of 10 metres in a well at the necropolis of Bernard (Vendée): Marcel **Baudouin.**—The influence of acidity on enzymes: P. **Petit.**—Chemical researches on the thyroid apparatus: Jean **Chenu** and Albert **Morel.** It is possible to differentiate by chemical analysis between the thyroid and parathyroid bodies, the latter containing much less iodine.—The effect of ablation of the liver on the coagulation of the blood: M. **Doyon** and N. **Kareff.**—Contribution to the study of sand filters: M. **Marboutin.**

DIARY OF SOCIETIES.

THURSDAY, April 28.

Royal Society, at 4.30.—Further Experiments on the Production of Helium from Radium: Sir William Ramsay, K.C.B., F.R.S., and F. Soddy.—The Effects of Changes of Temperature on the Modulus of Torsional Rigidity of Metal Wires: Dr. F. Horton.—The Sparking Distance between Electrically Charged Surfaces. Preliminary Note: Dr. P. E. Shaw.—Studies on Enzyme Action. Part II. The Rate of the Change Conditioned by Sucroclastic Enzymes, and its Bearing on the Law of Mass Action. Part III. The Influence of the Products of Change on the Rate of Change Conditioned by Sucroclastic Enzymes: Dr. E. F. Armstrong.—Part IV. The Sucroclastic Action of Acids as Contrasted with that of Enzymes: Dr. E. F. Armstrong and R. J. Caldwell.—Enzyme Action as bearing on the Validity of the Ionic-dissociation Hypothesis, and on the Phenomena of Vital Change: Prof. H. E. Armstrong, F.R.S.—On the Changes of Thermoelectric Power produced by Magnetisation, and their Relation to Magnetic Strains: Dr. S. Bidwell, F.R.S.—The Behaviour of the Short-period Atmospheric Pressure Variation over the Earth's Surface: Sir Norman Lockyer, K.C.B., F.R.S., and Dr. W. J. S. Lockyer.

Royal Institution, at 5.—Dissociation: Prof. Dewar, F.R.S.

Institution of Electrical Engineers, at 8.—Power Station Design: C. H. Merz and W. McLellan.

FRIDAY, April 29.

Royal Institution, at 9.—Westminster Abbey in the Early Part of the Seventeenth Century: The Very Rev. J. A. Robinson.

MONDAY, May 2.

Royal Institution, at 5.—Annual Meeting.

Aristotelian Society, at 8.—Kant's Idealism: G. E. Moore.

Society of Chemical Industry, at 8.—(1) The Determination of Minute Quantities of Bismuth in Copper and Copper Ores. (2) The Determination of Minute Quantities of Arsenic in Copper Ores and Metallurgical Products: T. C. Cloud.—The Estimation of Mercury: D. A. Sutherland.

TUESDAY, May 3.

Royal Institution, at 5.—Meteorites: L. Fletcher, F.R.S.

Zoological Society, at 8.30.—On the Osteology and Systematic Position of the rare Malagasy Bat *Myzopoda aurita*: Oldfield Thomas, F.R.S.—Contributions to the Anatomy of the Lacertilia. III. On some Points in the Vascular System of Chamæleon and other Lizards: F. E. Beddard, F.R.S.—Notes on the Gill-rakers of Polyodon: A. D. Imms.

Society of Arts, at 4.30.—Canada and Great Britain: W. L. Griffith.

WEDNESDAY, May 4.

Entomological Society, at 8.—Some Breeding Experiments on *Catopsilia pyranthi*, and Notes on the Migration of Butterflies in Ceylon: Major Neville Manders, R.A.M.C.

Society of Arts, at 8.—Statistics of the World's Iron and Steel Industries: W. P. Digby.

Society of Public Analysts, at 8.—(1) Cod Liver Oils and other Fish Oils; (2) Note on Mushroom Ketchup: J. F. Liverseege.—Note on Some Constants obtained in the Examination of Margarine: E. Russell and V. H. Kirkham.—Note on the Estimation of Sugars in Concentrated Malt Extract: A. R. Ling and Theodore Rendle.

THURSDAY, May 5.

Linnean Society, at 8.—British Freshwater Rhizopoda: J. Cash.—On Coloration in Animals and Birds: J. Lewis Bonhote.

Röntgen Society, at 8.30.—The Röntgen Society; its Past Work and Future Prospects: J. J. Vezey.—Some Experiments with Alpha Rays: F. H. Glew.

Chemical Society, at 8.—The Slow Combustion of Ethane: W. A. Bone and W. E. Stockings.—Note on the Hydrolysis of Starch by Diastase: J. S. Ford.—The Resin Acids of the Coniferæ. Part I. The Constitution of Abietic Acid: T. H. Easterfield and G. Bagley.—The Action of Radium Rays on the Halides of the Alkali Metals, and Analogous Effects produced by Heat: W. Ackroyd.—The Dynamic Isomerism of Glucose and of Galactose. Solubility as a means of Determining the Proportions of Dynamic Isomerides in Equilibrium: T. M. Lowry.—A Study of the Substitution Products of *ar*-tetrahydro-α-naphthylamine, *ar*-4-bromo-tetrahydro-α-naphthylamine and *ar*-tetrahydro-α-naphthylamine-4-sulphonic acid: G. T. Morgan, Miss F. M. G. Micklethwait, and H. B. Winfield.—The Additive Products of Benzylideneaniline with Methylacetoacetic Ester and Acetoacetic Ester: F. E. Francis and Miss M. Taylor.

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